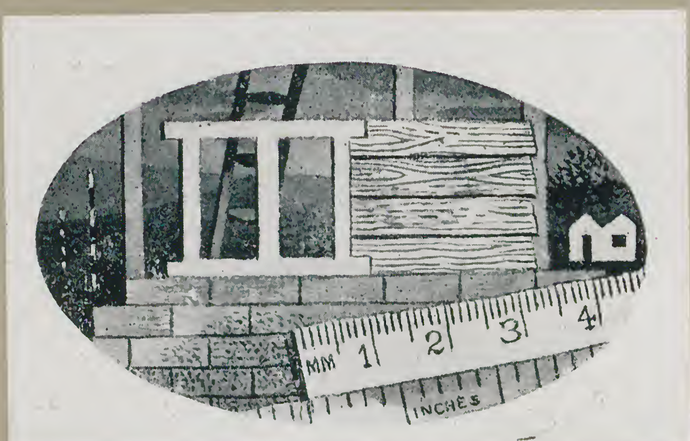
An Introduction to

STANDARDS IN BUILDING

D. Dex Harrison
A.R.I.B.A., A.M.T.P.I.



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Building Standards affect in one way or another half the industries of the country and here for the first time an attempt is made to give a clear understanding of the elements of this important subject.

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by

D. DEX HARRISON

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CONTENTS

ILLUSTRATIONS

INTRODUCTION

The subject of standardisation does not appear to have been covered in comprehensive form in any one volume. Perhaps it is one of those subjects that are not written about because they appear to be so very obvious, and yet it is clear that few recognise the full meaning and importance of standards. Works that have appeared on the subject seem to accept the basic grounds as read and discuss detailed points at issue, the only statements on general lines that we have come across being P. G. Agnew's article *Standards in our Social Order* written for the *Encyclopædia Britannica* and *The Role of Standards in the System of Free Enterprise* by Howard Coonley and P. G. Agnew. Our opening chapter is largely framed on these two brilliant statements of the argument for standards.

The British Standards Institution has recently issued *B.S. Handbook No. 3, Building Standards*, which, together with its *Supplement*, contains in condensed form many of the principal British Standards relating to building and which is invaluable as a reference. Any of the British Standards in complete form can be bought or consulted at the British Standards Institution. *Specification*, issued annually by the Architectural Press, is also a very excellent guide to building standards, discussing them in the context in which they are normally used in building. Lists of British Standards are also issued by the Institution either in complete form or classified industrially, one of these lists relating to building standards, although it will be found that many standards require to be consulted in the course of building operations which are not in the building list. It is indeed not difficult to find out what is standardised and what is not and no attempt is made in these pages to duplicate or amplify information that is so ably presented elsewhere. We set out to do what Agnew briefly sketched in his articles, to discuss the value and meaning of standardisation in our society and to define the gains and losses that are incurred in the process. We are, of course, concerned only with standards related to building, but building itself is a very wide subject and the discussion may be found to be of fairly general interest.

Standardisation is the very stuff and fibre of our present industrial civilisation and for good or ill it leaves a deep imprint on human affairs. In building we are emerging from a period of stagnation into one of the most intense activity and it seems an apposite moment to pass in review the apparatus of standardisation by which we hope to control our affairs. We shall find a mixed pottage, a serious lack of co-ordination, a lack of forward vision, a policy throughout of opportunism and improvisation where there should have been deep-seated, long-term planning. We find a tendency to look at things from our own national point of view only, when social and economical nationalism is obsolete. In five or ten years' time we shall assuredly have to scrap the bulk of our existing standards, for the next decade will be the decade of international standardisation and, though we need not fear this development, we ought to prepare for it.

There are rays of hope. A surprising number and variety of products have already been standardised at the international level; wireless wave-lengths, gramophone records, electric light bulbs, standard concert pitch for orchestras, a standard decimal classification system for libraries. Such are the unexpected and varied examples that occur to mind. Collaboration at this level can be obtained where there is willingness. No doubt cartelisation has fostered industrial standardisation at the international level but the librarians had no pecuniary motive to sustain their efforts. From being unheard of a decade ago, the policy of integration and co-ordination of sizes is gaining rapid and wide acceptance. We are hindered in this respect not so much by weak intentions but by the existence of several dimensional scales in different countries and this is as serious a barrier as obstacles of language.

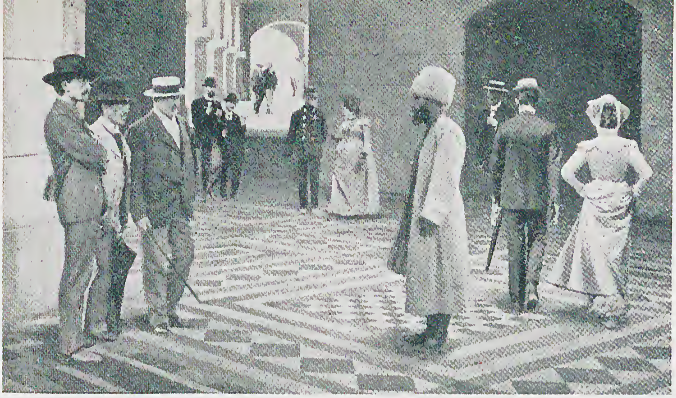
[TOP] *Gad, Albert! Feast your eyes on this fellow with the beard.*

[MIDDLE LEFT] *My darling Sarah, don't look now, but that lady's ankles . . .!*

[MIDDLE RIGHT] *Sada Jacco.*

[BOTTOM] *The gentlemen are obviously going to or coming from a function and have seen fit to dress identically for the purpose. The gentlemen with the fez have made what concession they could in adapting their garb to the customs of their hosts, the fez alone demonstrating their own fundamentally different, though equally rigid, standards of dress.*

We accept current standards of social pattern without question merely because we are brought up with them from birth and know no others. It is only when we are brought face to face with an entirely different set of patterns that we realise that our mode of life is governed by purely arbitrary standards of dress, education, codes of manners and religions. The patterns even of our own lives a couple of decades back are utterly incongruous to-day.






DEFINITIONS

In the widest sense standards arise as soon as human beings come into contact with each other. Original codes of conduct between man and man were the first embryonic standards. Without such standards men could not associate with each other in communities and, once communities are formed, a whole series of codes of conduct, or laws, must arise in order to maintain them. As the community develops, its codes increase in number and complexity. From the codes of basic conduct grow up codes of relatively minor significance—codes of manners; refinements which enable men to live together at more cultured levels.

We are introduced at birth to a whole series of codes of conduct, manners, fetishes, thou-shalt's and thou-shalt-not's. Our lives are conditioned in a manner prescribed according to the standards of the community, or a particular class or group within the community. Our every thought and utterance, under the name of education, is developed in certain preconceived directions, the entire framework of our lives is organised according to standardised patterns. We realise this clearly enough in the case of the bee or the ant, at whose world we can look with an objective eye. We find it more difficult to recognise the same organisational symptoms in our own existence. By the time we have reached maturity we have been conditioned to a given environment by the gradual and unconscious assimilation of countless standards, and it is only if we try to break away, or if we come up against the different standards of some other community, that we realise the straight-jacket nature of the limitations of the particular set of standards we have learned. Captain H. R. Robinson, in his book *A Modern de Quincy*, after trying vainly to adopt the life of a Buddhist monk and later of an opium eater, observes :

"*As I passed down the line of smoking couples for the last time I could not help but feel a pang of regret that I could not wholly*

It is not difficult to find examples of superbly integrated design in vernacular work. It used to be customary to employ local materials, and to use methods of construction in keeping, and the design sprang from these basic origins. We illustrate examples from Yorkshire [TOP], *Essex* [SECOND DOWN], *Buckinghamshire* [THIRD DOWN], *Bedfordshire* [BOTTOM] *and Surrey* [TOP FACING PAGE 16], *each perfectly in keeping with its setting, each achieving a satisfying unity of conception.*

adjust myself to their way of life. It was the cursed handicap of one's upbringing, the standards which willy-nilly are implanted in us with our mother's milk. All along, ever since I had felt the desire to get behind this mask of the Orient, to submerge myself in it, I had felt this handicap."

There is always a fear in the community that a standard is some new imposition. A community which accepts without query the countless existing standards by which it regulates its activities, will rise as a man against any attempt to add one more to the number, or even to subtract one. The human mind reposes at its ease when it is not subject to change and any proposed change raises seemingly automatic reflex actions in opposition. It is hard to introduce a new standard, but once that standard has been adopted by the community it is equally hard to get rid of it. This is not entirely due to mental inertia. It springs in part from the vested interest the community acquires in the standard it has adopted.

The apparently simple sartorial change from silk toppers to felt trilbys involved a minor industrial revolution. New types of industrial skill had to be acquired, the old skills became redundant and a dead loss to the community, countless thousands of perfectly good top hats, representing a further dead loss, reposed in the dusty obscurity of genteel cupboards. A community can only tolerate a limited number of changes of standard at one time if it is to remain socially and economically solvent.

Human beings, being gregarious, want to live together in communities and to satisfy this desire they are prepared to go a long way towards subjugating their individuality—to conform to rule. Their individuality, nevertheless, is constantly trying to assert itself and with each fresh inroad of standardisation it has to be "broken in". People want the minimum, not the maximum, degree of standardisation or pattern compatible with the idea of living together.

This repugnance of people to accept a new standard implies that standards can only be introduced if the need for them is established and this is a cardinal law of standardisation. Human beings will not willingly submit to standardisation simply for the sake of standardising: "*It was destroying a certain portion of liberty, without a good reason, which is always a bad thing*"—Dr. Johnson. Where a community does over-standardise itself, as seems to have happened in some countries recently, lassitude

and, ultimately, decay set in, as the incentive for individual thinking is withdrawn.

Fashions, manners, laws, customs, codes, conduct; all are broadly synonymous to the word standard, according to the definition. The *Shorter Oxford Dictionary* defines a standard as "*an authoritative or recognised exemplar of correctness, perfection, or some definite degree of any quality . . . A commodity the value of which is treated as invariable in order that it may serve as a measure of value for all other commodities . . . A definite level of excellence, attainment, wealth or the like or a definite degree of any quality viewed as a prescribed object of endeavour or as the measure of what is adequate for some purpose . . . Having the prescribed or normal size, amount, power, degree of quality . . . Serving or fitted to serve as a standard of comparison or judgment . . .*", and of standardise "*to bring to a standard of uniform size, strength, form of construction, proportion of ingredients*".

We prefer to define our word standard meticulously.

In this book we are dealing with only a fraction of the general field of standardisation, that part which comes under the classification "industrial standardisation" and with only a fraction of industrial standardisation, that part which deals with the building industry.

To the industrialist a standard, though it is a breathing point, is not a standstill. He would define a standard as the best way of doing a thing *at the moment*. To him a standard is always flexible and in motion, he is constantly raising his sights. Whereas the industrialist can and does maintain the flexibility of his own standards, which are entirely under his control, it is not so easy to alter nation-wide standards, for the formulation or alteration of which a general consensus of agreement is required. The standardising bodies are, however, well aware of this fundamental of their calling, this second law of standards—the need to maintain flexibility—and one should disabuse oneself of the conception that to standardise is to stagnate. The ultimate compressive strength for portland cement in this country has gradually crept up through revised specifications until it is now at the figure of 2,500 lb. per sq. in. after seven days, and reputable manufacturers are constantly keeping ahead of these rising standards by progressive improvements in their products. The benefit is rather more slowly transmitted to the building industry by increased allowances for

the strength of portland cement concretes in the various concrete codes.

A standard is, by definition, a relative agreement. Since perfection is not to be obtained in this world, it simplifies procedure if degrees of perfection are well defined. Any number of commercial law-suits are the result of not having a clear definition of the point at issue. What could be simpler than to decide whether a piece of shafting is 2 in. in diameter? Yet, if nothing more is specified a buyer may attempt to reject the material claiming it inaccurate, no matter how accurate it may be, since it is impossible to make a shaft exactly 2 in. in diameter. On the other hand, the seller may attempt to supply material so inaccurate as to be unusable, asserting that it is "commercially accurate". The solution consists in agreeing upon just how many thousandths of an inch departure from the ideal size shall be allowed.

It is related of a wealthy Bradford wool merchant that he attended the wool sales and bought vast quantities of wool without troubling to see the samples. When questioned on this he said Old-so-and-so (his competitor) had seen the samples, hadn't he? and was bidding, that was good enough for him.

All buying and selling which does not come under the personal eye of the buyer must rest upon some sort of standard, and the commercial world must have absolute confidence in those standards. Rule of thumb arrangements, such as "the same as per our previous order", may work very well up to a point, but the community which can obtain accurate specifications for its code of business relations is sure to gain in efficiency.

What Should Not be Standardised: we quote from Coonley and Agnew.

> "*There is no value in standardising merely for the sake of standardising, in uniformity for the sake of uniformity. To do so takes variety and spice from life.*
>
> *Standards should be set up only when doing so may be expected to result in important economies; to simplify and clarify operations; or to safeguard persons or property.*
>
> *It is idle to attempt to standardise style features.*
>
> *It is not the function of a standard to prevent the marketing of any product, no matter how inexpensive, but merely to enable the buyer to know what he is getting.*
>
> *Most business men think that the use of standards for commercial and technical purposes should be voluntary, and that they*

should be made mandatory under legal authority only when such a course is necessary as a protection to persons or property or to prevent fraud."

Speaking of industrial standardisation generally P. G. Agnew, Secretary of the American Standards Association, sets out the following broad categories under which standards can be framed:

Nomenclature
Dimension
Quality
Performance
Safety
Process
Type Limitation

Furthermore, he says, standardisation can take place at four levels:

Within a single organisation
Within an industrial group
On a national scale
On an international scale

Nomenclature

Languages are the basic standards of nomenclature. Lack of uniformity of nomenclature in the building industry results in confusion and even law-suits, and certain British Standards deal exclusively with a clarification of the way of saying things. An example is B.S. 589: 1935—Nomenclature of Softwoods, the preamble to which states: "to establish *a single standard name* for any one timber and to restrict that name to *one timber only*". It is to be hoped that this clarification of wood terms will ultimately do away with bastard general specification terms like "deal" and enable us to design more accurately for the given qualities of different timbers.

Other forms of this important category of standards are standardised symbols for drawing office practice and British Standard sequence of Trade Headings for Specification items (B.S. 685: 1937), the latter an attempt to achieve a much needed uniformity in specification writing.

Generalised specification clauses, too, such as used to clutter up old-time building specifications and were quite meaningless in practice: "all materials shall be the best of their respective kinds"

or "workmanship shall be of good quality", can be replaced with simple precise references: "Clinker shall comply with B.S. 1165: 1944", which allow of no dispute.

In a wide sense most standards are definitions, they define what is meant by terms, as we have just instanced in the case of a 2-in. shafting.

Dimension

Dimensional standards need little introduction, so obvious is it that, before any building can be committed to paper the designer must know in what sizes he can obtain the constituent products. B.S. 990: 1941—Metal Windows and Doors, is primarily a standard of dimension, its quality characteristics being secondary. The one important factor that has emerged is that standardised sizes must be co-ordinated to promote a more ready interchangeability of parts. Dimensional co-ordination, sometimes called Modular Co-ordination, has a chapter to itself later in the book.

Quality

"The percentage of lime, after deduction of that necessary to combine with the sulphuric anhydride present, shall not exceed 2·8 times the percentage of silica, plus 1·2 times the percentage of alumina, plus 0·65 times the percentage of iron oxide, nor be less than two-thirds of that amount. The ratio of the percentage of iron oxide to that of alumina shall not exceed 1·5." This quotation is part of the stipulations of quality for portland cement laid down in B.S. 12: 1940. All the user needs to do is to order so many tons of portland cement to B.S. 12: 1940 and he will know that the plain grey powder he receives measures up to all these requirements. Instead of having to test every consignment he relies on the hallmark of the standard of quality. The standard of quality may be very high or it may be very low, but it will be accurately defined.

Performance

Quality and performance are to some extent interrelated. A material might, however, have several performance characteristics in different functions and a standard might apply to a

special performance in one function only, for which the quality of the material might not matter, or vice versa. Thus, glass is described as: glazing quality, selected glazing, specially selected, or plate. The performance of all these types, so far as exclusion of weather and longevity are concerned, is the same, the quality is different.

With timbers, the quality may depend upon the value of the timber as a decorative finish, the performance on its strength and freedom from movement. B.S. 940: 1944: Grading Rules for Structural Timber, is concerned only with performance as such.

Safety

Standards of safety are necessary to safeguard human beings from accidents. Parts of the Factory Acts deal with this aspect of standardisation, specifying safety precautions to be taken with dangerous machinery, such as band saws, belting and guillotines.

Our sanitary bylaws are also standards of safety, designed as they are to avoid the danger of disease due to faulty workmanship. Some people think they err too much on the side of caution.

Process

Process standards perhaps concern the manufacturer more than the user of his product. He must regulate his process by strict standardisation in order to maintain the uniformity of his product.

The machine tool has its influence on process standards, often dictating them, as in the case of steel strip mills or board mills, the width of the product being standardised according to the capacity of the machines.

A process may also be standardised throughout an industry because of the introduction of a machine which does the work so much more efficiently than its rivals that it attains to general use.

Type Limitation

A great deal of effort is being applied to reduce the enormous number of different products to more manageable proportions. This form of standardisation has received a big fillip during the war because of the paramount necessity to reduce replacement stocks. Every separate product means a pile of replacement parts wherever it is used and this one problem alone could have wrecked

the whole war effort. Belligerents cut down the number of types to the absolute minimum, even at the expense of a sacrifice in efficiency. Such an apparently small item as the size and pitch of screw threads created a permanent headache to the allied screw thread unification committee who are still sitting on the matter, as indeed they were after the 1914–1918 war. We tend to ease up on type limitation as soon as immediate danger is past and these basic co-ordinations are always the most difficult to put over, as so many interests are involved.

It can be assumed that there is an optimum number of types of products of any one kind that could be produced at any time, for too strict limitation might easily do more harm than good by eliminating necessary alternatives and putting a bar on progress. The problem is to find this optimum.

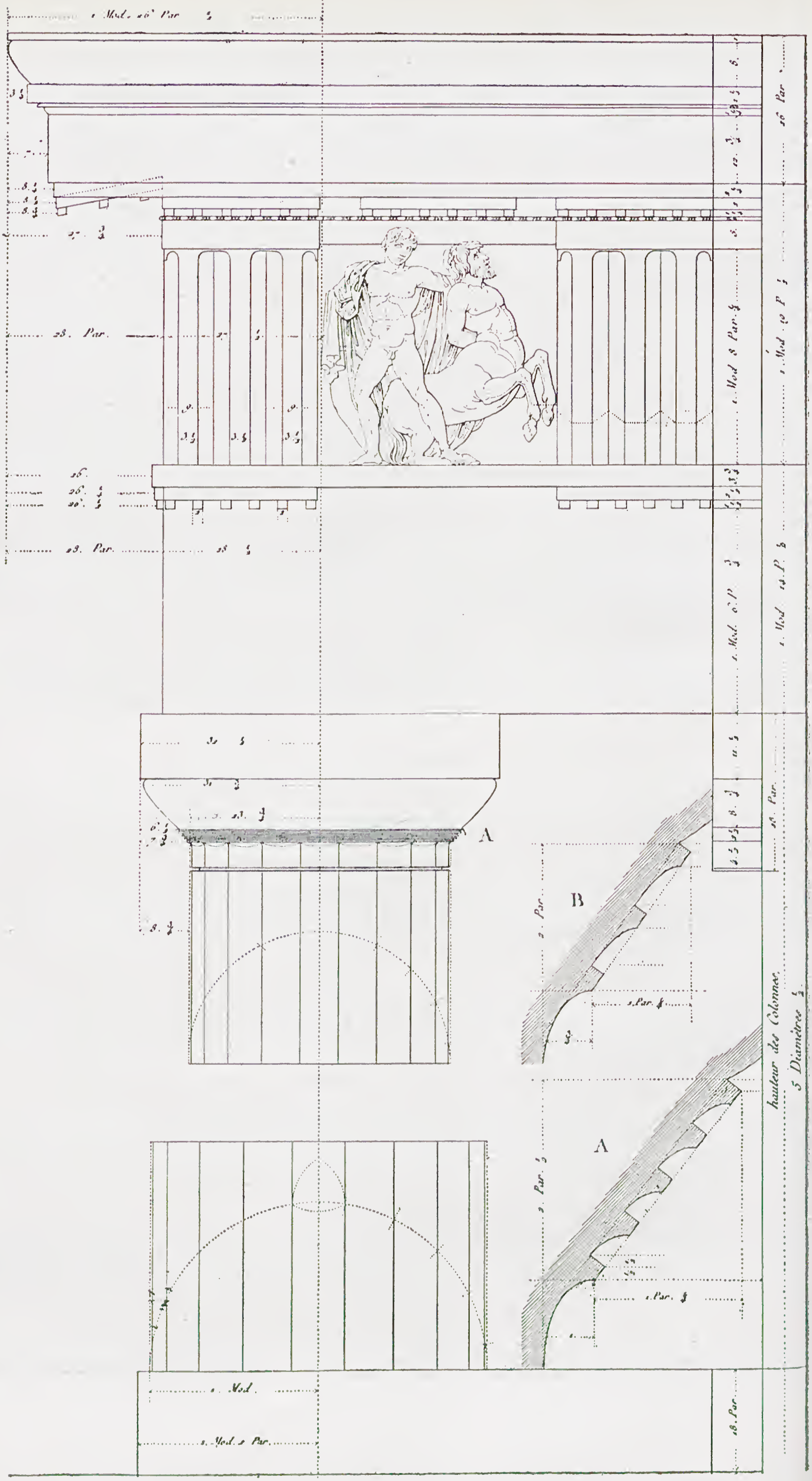
The Four Levels of Standardisation

Traditionally, standards have usually first been formulated at the level of the single organisation. Where they have succeeded the tendency has been to have such local standards adopted for an entire industry. Some of these standards have gone on to attain national and even international status. An example might be quoted of the Edison-type screw lamp caps, the name indicating the local origin.

Early standardisation came about through a gradual evolutionary process and with little conscious direction, a sort of "natural selection" being used to weed out the unsuitable and leave only the most fitted. With the increasing complexity and maturity of industry, towards the latter half of last century, the tendency grew of formulating standards by conscious effort at higher levels.

To-day, when standardisation is recognised as essential in the interests of the State, standards are being more and more formulated at the upper levels. National standards are put out with government backing. The present decade is essentially one of standardising at the national plane. The next decade will be one for standardisation at the international plane.

[TOP] *See footnote page 9.* [BOTTOM] *The modern scene has lost its roots with tradition and spreads its riff-raff over a site to which it is utterly alien. The whole is not at one with its setting and the parts are not even at ease and atoned with each other. All is restless and unresolved, and ugly and hurtful to the spirit. Each item tries to advertise itself, and that is sometimes the chief reason for its existence. Here is displayed an absence of integration at any level, symptomatic of our modern times. Compare with the traditional example illustrated above and those opposite page 9.*



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The advent of the now cliché atomic age leads us to altogether new perspectives. Already the purely national boundary is a thing of the past, even though it should persist politically for some time to come. Technically we have reached the era of international relationships and international standards. These matters are discussed at greater length later on, the important point to bear in mind is that insularity in standardisation is out-dated as surely as it is in the political sphere.

[OPPOSITE] *Doric order from the Parthenon laid out on the scale of a module divided into 30 parts, from Norman's* Parallel of the Orders of Architecture.

INTEGRATION AND DIMENSIONAL CO-ORDINATION

Any consideration of building standards at the present time implies picking up threads, some new, some very worn, which have accumulated over many years. Standards, customs, accepted ways of doing things, will be found to apply to every aspect of the industry and some of these methods have applied with little modification through centuries. Thus, the method of firing, making and putting together brickwork has not altered appreciably in hundreds of years, whereas the new machined materials are being introduced with altogether new conceptions of form, texture and precision.

The building trade is in the unenviable position in this period of violent upheaval, of being itself in the throes of a change over from the individual work of the craftsman to that of the machine. The machine demands sharper and more rigid standards than the work of the craftsman whose standards (in the name of customs) were permissive and capable of being moulded to his hand. These two forms are at variance, but the standardising conception in the industry has rather developed from the aspect of craftsmanship than from the machine—each item is standardised as a separate problem, assumed to be *in vacuo* at the time.

Though spoken of in the singular, the building industry is really a collection of different industries, some of which are totally unrelated to each other. As an instance, brickmaking is essentially connected with building and with little else, but the various industries in the electrical group making cables, wiring, electric fitments, refrigerators and a host of other articles, are only in part building industries; in part they cater for markets which have nothing to do with building. Nor have these industries any connections with brickmaking.

The building industry is a cross section of the industry of half the nation. As such it is involved in the bases of standardisation adopted by each and every industry that supplies parts for buildings and, in the past, though each separate industry might have achieved a fair and rational measure of standardisation within its own sphere, these different bases have not been by any means

coincident. The architect and contractor, whose task it is to organise various materials into a building, are posed an insoluble problem because of this lack of unity in the materials which are the tools with which they work. Obvious examples occur in dimensional sizes, where metal windows, standardised at the national level, do not fit brick dimensions, also standardised at the national level, and the laborious cutting of bricks around the reveals is the inevitable and accepted result.

The brick, one of the oldest of our materials, has indeed only very recently been standardised on a national scale and such is the force of tradition that, in the North until a few years ago, four courses still rose 13½ in. as against 12 in. in the South. Clearly, metal casements could not be made to coincide with two such standards and it is no surprise to find that, perhaps in consequence, they coincide with neither.

When the first industrial standards achieved their national status the sense of achievement was such that the fact of their being all on different bases seemed of minor importance, something that could be put right in the course of time. The course of time, however, has seen the establishment of one set of unrelated standards after another, each one making it more difficult to achieve a fresh start on a properly co-ordinated basis. The poor brick, by its versatility, has been made scapegoat for these botched standards and it has had to be cut about unmercifully to enable the wretched materials to be built into the structure at all.

The common brick has been the accommodating buffer or matrix into which these diverse and unrelated standards could be set without jostling each other too closely. Where brick or masonry was not available timber was also sufficiently accommodating in its ability to be cut to measure, so that discrepancies in the standardised articles were not noticed. Thus, the problem of integration could be stalled almost indefinitely, rather like a disease that continues to grow with no appreciable external results until its host suddenly dies. The problem has been stalled and we are approaching a critical phase in the malady.

The question is coming to a head because of the rapid development of prefabrication. The essential element we have to note in prefabrication is that the accommodating site matrix, be it brick, masonry or timber, is discarded in favour of the accurate assembly, one to the other, of factory-made parts. The matrix has gone, the various elements of the building must fit accurately

together, cheek by jowl, without cutting or adjustment of any sort. The prefabricator *must* integrate his parts.

It would be preposterous to suppose that one half of the industry must of necessity integrate itself whilst the other half remains completely unintegrated, for the prefabricator draws his material from the same sources as the traditional builder. Both use wallboards, metal sheeting, asbestos products, built-in equipment. One cries out for the integration of these elements, the other doesn't mind much but would benefit more than he knows if it were accomplished.

From this hiatus, two interrelated conceptions have arisen: integration, and its offshoot dimensional co-ordination.

INTEGRATION

Integration is implicit in all we have said on standards. A standard, besides being good in itself, must be integrated with other standards, and with its context, to gain its maximum effect. This is a truism that has, nevertheless, been sadly overlooked, and although a good deal of lip service has been paid to the ideal, standards that have so far matured have shown very little signs of integration.

In the U.S.A. there has been much talk about integration. The conception has been advanced from that of a mere mechanical fitting together of parts to embrace design qualities, fitness for purpose, function, and so on. They talk about "integrated design" in the sense that different elements are successfully absorbed into the concept and lack of integration when they are not, even though the individual parts are perfectly good in themselves. All good designs are integrated inasmuch as they achieve unity of expression, but in contemporary building, integrating a series of finished elements into a satisfactory whole might easily be the chief problem of the designer, his job might consist of little else but that.

It is important that the parts which are to be integrated are considered and designed in the first place with this in mind. We embrace here not only dimensions but style, quality and performance. The cooker needs to agree in overall dimensions with the sink-top and working table and with the refrigerator, electric-washer or with whatever it is in juxtaposition, but it equally needs to coincide with these elements in respect of its finishes, its length

of service and its initial cost. We do not want a cooker that gives in on us five years before the rest of the equipment and has to be replaced. We do not, for that matter, want a cooker that is standardised in half a dozen primary colours and a refrigerator that is produced only in the most delicate of pastel shades, all of which clash with the aforesaid. Still less can we stomach a cooker streamlined in the manner of the New York–Chicago Twentieth Century Limited if we have succeeded, in the rest of our equipment, in avoiding this sort of blandishment from the industrial super-stylist.

Successful integration, therefore, is more than the mere pulling together of our standards—it is the achieving of an attitude of mind, a unity of purpose, a unification of our whole building environment and, therefore, of our whole social environment. It is fashionable to regard the Georgian era in this country as one in which cultural and social integration achieved its highest expression. Then, one culture permeated through the whole effective structure of society and the result was a pleasing, harmonious and thoroughly integrated whole. But how much more complicated is our problem to-day? We lack the overall culture of the Georgians, we are required to integrate into our environment hundreds of fresh gadgets, not all of which lend themselves readily to commodious usage: the water closet, the petrol pump, festoons of plumbing pipes, electric lighting, and we are supposed to combine these convincingly with the continued use of rustic bricks, reed thatch, open fires, persian rugs and crystal chandeliers. Integration, clearly, awaits a cleaning out of our mental box rooms before it can get properly under way.

If it were just a question of gadgets, integration might be attainable after a healthy and ruthless spring clean, but the gadgets are, after all, a result of our thought processes and ideals, which are at variance in different individuals and strata of society.

The Georgians were not faced with the wen, the unintegratable, product of a hundred and fifty years of blindness, greed and neglect. They had a clear-cut environment of handleable proportion, by the side of which our problem is appalling in its immensity and truculence. When, later in the work, we come to discuss design standards, we suggest that our overall cultural level is hardly such at the moment as to encourage too much integration, for integration, to be worth while, implies a high general standard

of culture. In an inverted sense, the wen itself was integrated—it was certainly built consistently at the lowest conceivable level, there was a horrifying unity of purpose about it, and one is afraid that integration at the present time would be a pausing at too modest an achievement. How hard are we trying to integrate living environment in our bomb-shattered towns at this very moment, but how superficial, hurried and banal are most of the results? Future generations might well curse us rather than bless us for putting so much on paper in the form of Town Planning projects when we have so very little substance to put down.

When craftsmanship ruled, standardisation was limited to customs and accepted ways of doing things. These in turn were applied to the form the buildings took and we find throughout history, a series of accepted "styles" of building, each of which became an exclusive fashion of the time and each of which contributed a rigid series of rules of proportion and taste as its forms hardened or resolved.

Our present confusion is illustrated in an extreme degree when a contemporary structure is dictated by the latest codes of practice for steel structures in respect of its frame, by the craftsman's standards and customs of bricklaying and masonry wall technique in respect of the clothing of the frame, and by the Greek module in respect to the design applied to the clothing. Each conception taken alone is perfectly valid. If bricks can be laid well in accordance with custom there is no reason why they should not continue to be so laid. The fact that the custom is an ancient one does not invalidate it. Similarly, the proportions of the Greek orders do not depreciate with the passing of time. The confusion arises when the standards of different epochs, founded upon entirely different sets of conditions, are combined together in the one constructional process. The steel frame code is arranged, quite properly, to support the building, for that is the function of the frame, but the Greek orders were also coded by the Greeks in such a way as to support the building. So, for that matter, brickwork has been developed essentially as a weight-bearing material. To use three different codes of building out of their proper context, any one of which could give the needed support, is wasteful, insincere and surely symptomatic. The brickwork is just an added load to the frame, the Greek orders are cored out like an old rotten tree.

Our basic problem is to devise a code of building which will

reflect the needs of the community in which we now live and will advantageously utilise its technical achievements.

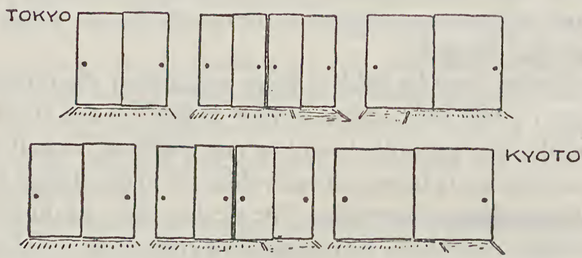
Finally, the tempo of our times introduces its own problems. Ronald A. Wank, writing in *New Pencil Points*, put the matter in pithy American: "*During the advance from farmhouse to Radio City, as soon as the architect absorbed one of the new contrivances and came up for air, technological development pushed him back under with a couple of new ones. Just when radiators were made to behave in their flush spandrel recesses, air conditioning made them irrelevant altogether; and after door-closers yielded to the inconspicuous Rixson hinge, frameless glass slab doors and electric eyes began to throw all known kinds of hardware into the discard.*"

The Greeks may be said to have originated the conception of integration when they laid out their orders on the strict basis of the module. The module, it will be remembered, is half the width of the column at its base and each element in the design was based upon the modular dimension. The design that resulted from this dimensional effort was, of course, integration at its highest level and went far beyond mere dimensional co-ordination to embrace proportion and unity of purpose.

Not so widely known, but even more instructive to us at present, is the Japanese co-ordination of proportion based upon the size of the floor mat or *tatami*. We quote from Bruno Taut's book *The Houses and People of Japan*:

> "*Thus it was a natural consequence of this good technique that all parts of the building were standardised in the highest degree. The lengths of all timber have their fixed measures with a slight margin, all based on the size of the mats. According to the number of mats meant for a room, the length and breadth of the pillars are calculated. The height of the sliding doors in that case is kept the same, but the supporting timber adjusts itself to the length and breadth of the mats. . . . One thing renders the construction a little difficult even for the Japanese. This is that the size of a mat in Tokio and that in Kyoto are not alike. Kyoto has generally adhered to the ancient comfortable and worthy 'taste of the Emperor', the mat being 6 ft. 3 in. long. Formerly, the mats were 6 ft. 6 in. long. In Tokio the people are thrifty and their mats are accordingly only 6 ft. 0 in. in length. As Tokio has had a greater influence, the size of bedding and cushions have also been adjusted to these measures, in addition to the building dimensions.*

Contemporary Japan, with its population ever growing taller, ought to turn back again to the old Kyoto traditions. As in the whole of Japan, the length of one mat is a standardised measure with a special name and the area of two mats, which is the square of the length of one, has also such a standard name, a system exists in which generally accepted terms do not correspond with precise measurements. But the measures of sliding doors, the Japanese word for which is, in translation, 'inside norm', are all over the country nearly alike in their height of 5 ft. 8¼ in.



As the posts correspond to the mats so do the sliding doors between the posts. In these we can best see the decisive difference between Tokyo and Kyoto taste. Mostly two partitions of sliding door correspond to the length of one mat or four partitions to one and a half mats. Occasionally, two partitions of sliding door are together one and a half, and at times even two mats long. The boards for the floors of the corridors and verandahs are from one and a half to two mats in length. . . . On the top floor the beams lie at a distance of half a mat's breadth from each other, on the ground floor, in good workmanship, only a quarter of a mat's breadth", and finally, "*and the mat plaiter specially works the mats that have to fit into the rooms of a new building, making them so exactly to their prescribed size that it is impossible even to stick a piece of paper in between the joints. Thus Japanese standardisation does not mean a manufacturing for stock in the modern way; it does not mechanise construction or eliminate handicraft. The mats, the most standardised product in Japan, are made by hand entirely.*"

Here, then, we have integration. Dimension, proportion, design, function—all controlled for the one object of spiritual harmony; an anticipation by several centuries of our new awakened

need; a oneness of cultural attainment such as surpasses our own Georgian period.

All these periods, Greek, Japanese, Georgian, had this in common, they had achieved a cultural balance, a state of rest, a unity of spirit and outlook, a halting place in the progressive (or retrogressive) march of civilisation where human beings could pause and look about them without the super urgent need to be pressing ahead. We are seeking integration to-day without having achieved such a state in our society, without even being in sight of it. We are in the midst of a feverish pressure which is driving us forward, but if we seek forlornly, we cannot, therefore, cease to seek.

Surely these three periods of different culture, but of uniformly exquisite taste, provide an answer to those who believe that integration, correlation, dimensional co-ordination, standardisation itself, will produce monotony and a general atrophy of art. The danger is there, let us freely admit, but it is not inevitable. A cultured people can manipulate a high degree of standardisation with a high level of cultural attainment, a less cultured people would not come to so happy a result.

Dimensional Co-ordination

Integration, in the wider sense so far discussed, is a matter for ultimate rather than immediate realisation. Industrial production has, however, reached the stage when the question of co-ordinating at least the dimensions of elements that are to be standardised cannot continue much longer to be shelved.

Consider for a while the examples of building elements that are standard in this country at the present time. Is there any discernible relation between them? We have pointed out that so long as they are to be fixed together in a flexible medium such as brickwork, their individual shortcomings may be masked, but once they have to come together and fit without a cushioning medium their lack of integration in dimensioning makes the process quite impossible.

The dilemma does not assert itself so suddenly. In fact, to date, the matrix has always been available—there is no immediate thought of departing from brickwork for building in this country. The present emergency, which is throwing up an outcrop of prefabrication, is looked upon purely as an emergency; it is hoped to revert to brick as soon as the emergency is passed. Prefabri-

cation is a stopgap to fill in an awkward moment and to be dispensed with thereafter.

This being our philosophy, it is small wonder that our building standards have been framed and continue to be framed on the assumption that the matrix will continue to be available and that the urgency is not so great.

Our standards are not, therefore, integrated. A partial exception is made of the kitchen where American example has forced integration upon us, our kitchen fitments are more or less loosely integrated so as to fit one to the other, there being in this instance no matrix available to provide the foil. We have a situation, therefore, where one minor building element, the kitchen, is tolerably integrated and where no attempt whatsoever has been made to co-ordinate contiguous parts of the building and, in a sense, a dangerous precedent has arisen. The question is posed: Should we not now co-ordinate our various building elements so that they will fit in with the co-ordinated kitchen? It seems, at first sight, a sensible thing to do, but even to pose the question raises a bigger one: Is the kitchen the right nucleus on which the whole fabric of co-ordinated building dimensions can be built? Clearly, we cannot build up a satisfactory universal system of co-ordination on such hole-and-corner reasoning. The Japanese, be it noted, did not co-ordinate their house on the 6 ft. ×3 ft. mat but on the human form, the mat being merely the devised instrument to achieve the end.

There is another manifestation of day-to-day logic that needs rooting out. Our small house is pretty strictly standardised for the next decade at a floor area of 900 ft. sup. We discuss this type of standardisation by legislative pressure elsewhere. At the moment, we have to note that a planning grid—it can hardly be called a module—of about 3 ft. 6 in. is gaining great favour with prefabricators. It is easy to see why; a requisite number of squares of 3 ft. 6 in. dimension in the most economically shaped house, and excluding those parts absorbed in the external walls, adds up to just about 900 ft. sup., *ergo*—this is the correct planning grid. The argument is reinforced by the fact that the standard metal window will usually fit into units designed to this grid, *ergo*, it is doubly correct. Here is, nevertheless, an example of false reasoning. We do not necessarily say that 3 ft. 6 in. is wrong as a grid, but we do say that it should be arrived at by more fundamental arguments. On these arguments any increase in the standard of space allotted

to human beings, and 900 ft. sup. is a minimum imposed rather by the stringencies of the time than by consideration of amenity, at once invalidates the basis of the grid adopted, as does any alteration in the standard casement sizes. We cannot afford to gear our whole machinery of standardisation to such casual and ephemeral models.

Though our legislators are placidly continuing to treat each problem of standardisation as individual and unrelated, and though prefabrication continues to be thought of as a temporary expedient, it is quite certain that events will very soon show the fallacies in both these viewpoints. Fundamentally, prefabrication is based upon the production in the factory of more and more, larger and larger, and yet more complicated building elements, and it is already an integral part of the normal building industry. It happens that the production of prefabricated elements for stock, elements such as asbestos cement products, corrugated iron sheets, doors, windows and the like, has reached immense proportions and cannot proceed much further without embracing the whole house. Once we start to use prefabricated walling elements of any considerable size, we find that we lose our matrix (brickwork) and the whole bundle of unrelated items is discovered to be valueless. Thus we see that, to date, prefabricators have always had to design their own complete system of building so as to ensure that all the parts fit, and this has meant that only the big firms have been able to adopt prefabrication in its full sense. They are the only firms that can undertake so vast a project as the production of all the elements that go to make up a house. The smaller man, who might well be in a position to make, let us say, concrete walling slabs for sale, is in a dilemma because he does not know what size to make them. So long as the sizes are small the problem is not very difficult, he can turn out 18 in. × 9 in. slabs and be tolerably sure of a market, such slabs are merely specialised masonry forms for which the rough integration of the 3-in. brick unit suffices, but if he wishes to produce cladding slabs of a bigger size he is not on such safe ground. It is useless for him to decide on slabs 4 ft. × 2 ft. unless they are going to fit current standard window sizes and we need hardly say that if he decides on a size that will agree with standard timber casements it will not agree with steel casements, and vice versa, and a builder may find that these particular slabs are no use for the cladding of a house of exactly 900 ft. sup., because they result in too big

or too small a carcase and that the standardised equipment just does not fit snugly inside.

We have so many bases for standards at the moment that the small men cannot produce prefabricated parts for stock and our building drive is being held up in consequence. The only known solution is to lay down a common dimensional grid or module, so that a repertoire of interchangeable stock parts can gradually be built up.

Because of the failure to lay down such a basis we are being faced with a limited selection of official or officially sponsored designs which it is proposed shall be produced on an immense scale. This, in fact, is the only alternative which can achieve the necessary volume of production, and it achieves volume at the expense of variety and flexibility and by maintaining monopolistic practices on the part of big business or government.

The predesigned house, which may be well or ill designed, is offered to the public by the hundreds of thousands, for it is only by production of this order that economy can be attained. Moreover, only a limited number of such designs can be offered, for if there are too many they compete with each other, and the market is too small for them to attain the necessary economy.

There are only two approaches to prefabrication, the production of standardised units, or the production of specialised designs. *Dimensional co-ordination is the necessary key to the production of standardised prefabricated articles for stock.*

Units of measure

We have seen how the Japanese developed their dimensional system on the size and requirements of human beings. If, for a moment, we turn back to the origins of our own measures of size we find similarly that human proportions and scale have been the determinants. Simple methods of measuring, still in use, include the span of the hand, the breadth of the hand, the length of the human foot, of the human stride, of the arm from the shoulder to the finger-tips. Mr. Arbuthnot, in his excellent work *Tables of Weights and Measures*, 1727, lists the English measures of length, illustrated opposite. Note the names of these measures: Inch, palm, span, foot, cubit, yard, pace.

These he compares with Grecian, Roman and Scriptural measures all based upon similar human proportions, and having, therefore, broadly similar values, but all differing slightly.

English meaſures of length

Inch											
3	Palm										
9	3	Span									
12	4	$1\frac{1}{3}$	Foot								
18	6	2	$1\frac{1}{2}$	Cubit							
36	12	4	3	2	Yard						
60	20	$6\frac{2}{3}$	5	$3\frac{1}{3}$	$1\frac{2}{3}$	Pace					
72	24	8	6	4	2	$1\frac{1}{5}$	Faddom				
198	66	22	$16\frac{1}{2}$	11	$5\frac{1}{2}$	$3\frac{3}{10}$	$2\frac{3}{4}$	Pole			
7920	2640	880	660	440	220	132	110	40	Furlong		
63360	21120	7040	5280	3520	1760	1056	880	320	8	Mile	

ROMAN *meaſures of length*

										Engl. Paces.	Feet.	Inch. Dec.
Digitus tranſverſus										0	0	0,725$\frac{1}{4}$
$1\frac{1}{3}$	uncia									0	0	0,967
4	3	palmus minor								0	0	2,901
16	12	4	pes							0	0	11,604
20	15	5	$1\frac{1}{4}$	palmipes						0	1	2,505
24	18	6	$1\frac{1}{2}$	$1\frac{1}{5}$	cubitus					0	1	5,406
40	30	10	$2\frac{1}{2}$	2	$1\frac{2}{3}$	gradus				0	2	5,01
80	60	20	5	4	$3\frac{1}{3}$	2	paſſus			0	4	10,02
10000	7500	2500	625	500	$416\frac{2}{3}$	250	125	ſtadium		120	4	4, 5
80000	60000	20000	5000	4000	$3333\frac{1}{3}$	2000	1000	8	milliare	967	0	0

SCRIPTURE meaſures of length.

								Engl. Feet.	Inch. Dec.
Digit								0	0,912
4	palm							0	3,648
12	3	ſpan						0	10,944
24	6	2	cubit					1	9,888
96	24	8	4	fathom				7	3,552
144	36	12	6	$1\frac{1}{2}$	Ezekiels Reed			10	11,328
192	48	16	8	2	$1\frac{1}{3}$	Arabian pole		14	7,104
1920	480	160	80	20	$13\frac{1}{3}$	10	Schœnus meaſuring line	145	11,04

With the fall of Rome, the art of measuring was lost. At the beginning of the Saxon period it reverted to the use of approximate human standards, the ell, from the length of the arm, and the rod, pole or perch from the usual distance between roof principals of a house. These units were of different lengths in different parts of the country, perches being five, seven or eight yards. This variation in measurements encouraged fraudulent trading and in spite of difficulty of uprooting established customs, successful efforts were made to co-ordinate standards. In 1439 the 40-in. ell was prohibited by law and Henry VII later fixed the standard yard, its length being 35·963 modern English inches, differing by only ·037 in. from the modern yard.

Meaſures of Length of Several Countrys taken from Greaves, Azout, Picard, and Eiſenſchmid Reduc'd to English Feet & Inches.

		Inches
Engliſh foot	1000	12.
Paris foot	1068	12,816
Venetian foot	1162	13,944
Rhinland foot	1033	12,396
Strasburgh foot	952	11,424
Norimbergh foot	1000	12.
Danzlick foot	944	11,328
Danish foot	1042	12,504
Suediſh foot	977$\frac{3}{4}$	11,733

Mr. Arbuthnot's comparison of several local measures of his time, 1727, all based on the human foot. The introduction of the metric system at the end of the century rendered all these local measures obsolete, with the one unfortunate exception of the English foot.

An economy of any complexity cannot develop without basic standardisation of its units of measure. We have the same problem to-day on the world plane instead of the national plane—in place of yard read yard and in place of ell read metre. Our economy to-day is not a national but an international one and we are trying to run it by localised standards, yard, metre, etc., which have no more relation to each other than had the ell-yard confusion.

Thus an English manufacturer makes wallboards 4 ft. wide, a convenient nomenclature, but when he exports them they become 1·213 metres, a monstrous absurdity—yet in a continental building catalogue you will find numerous such instances. The exporter is forced, either to forget the absurdity of the transcribed size of his product in the new dimension scale, or to manufacture two ranges of size—an uneconomical procedure which involves, either the putting down of separate machinery, or the running of existing machinery uneconomically—i.e. turning out a metre strip from a machine that could be producing a 4-ft. strip.

Where industries producing intermediate-stage products which rely upon subsequent combination with other articles for their fulfilment reach the international plane of organisation, and rely upon a good deal of export trade, they are forced in their own interests to standardise at the international level and on the metric basis.

A failing of our own measures of length, apart from the obvious one that increases and multiplications are absurdly complex, would seem to be that human beings have increased in size over the past few hundred years and are going on increasing in size. A system of measuring based upon the scale of human beings even two hundred years ago, is likely to prove rather cramped to-day. This is a serious matter in building, where we are planning for the physical needs of human beings and, in fact, we do find that the instruments of measure we use are now too cramping. The British yard is just not enough for a passage or stair width, two yards are just too little for the length of a bed or the height of a lintel. We get over this by ignoring our measures and resorting to fractions, but the fact remains that our measures have become a hindrance rather than a help.

It happens that the metric system provides us with a measure more in scale with present human needs and it would obviously be good long-term policy to foster the metric scale in preference to the yard. It is interesting to note that the 40-in. ell prohibited in 1439 is being sponsored to-day in many quarters as a suitable module on which to base dimensional co-ordination. We now need the extra few inches with which Henry VII could dispense.

The introduction of the metric system was the first attempt to use a scientific basis rather than a human basis for measures. In theory a metre was to be one ten-millionth part of a quadrant of the earth through Paris, but in practice the standard metre is now

defined by an iridio-platinum rod held by the International Conference of Weights and Measures at Sèvres and by secondary standards in each of the thirty-one subscribing countries. Michelson has shown that a standard of length might be restored if necessary by reference to wave-lengths of light, e.g. a metre equals 1553163·5 wave-lengths of the light ray of the spectrum of cadmium, in air at 15° C. and 760 mm. It is thus obvious that the metric system is no more "scientific" in its basis than any other and its success might be ascribed principally to its simplicity. For our purpose it is of value in that it is, whether by chance or design, in excellent human scale.

The metric scale came into being as a result of action by the French National Assembly in 1790 and was adopted in France as law in 1799. It is now obligatory throughout Europe and in most South American countries and its use is legalised in Egypt, Great Britain, Japan, Russia, Turkey and the United States. Persistent attempts to make it obligatory in this country have failed.

The British system of measures is current in Great Britain, the Dominions and Colonies and the United States.

To some extent local measures are used side by side with the main trading measures in various backward countries.

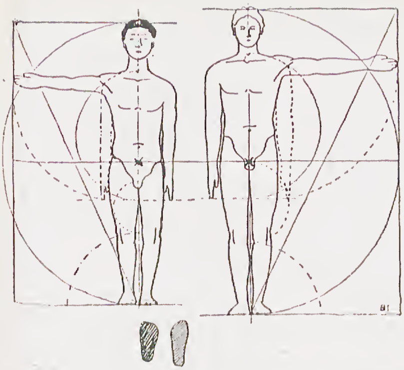
As internationalism grows apace, all forms of insular measures will tend to die out, amongst them our British measures, and nations which find themselves attached to such insular and local conceptions will be at a disadvantage in relation to nations which use the accepted international standards.

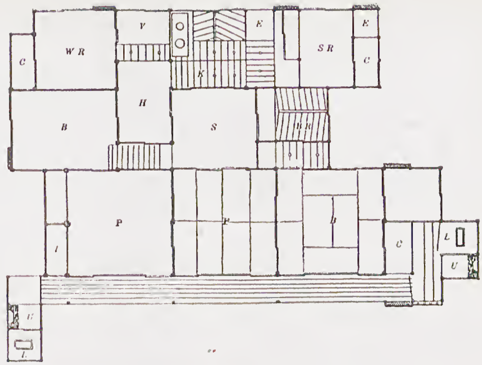
[TOP LEFT] *Proportions of the Japanese and European figures. Japanese houses are designed to satisfy the requirements of Japanese people who are shorter in stature than people of Western Countries. We need more ample measures in our houses than are used in Japan.*

[TOP RIGHT] *Plan of traditional Japanese house, which shows how the layout is based on the standard size of mats, the whole forming an essay in modular co-ordination as well as integration, which latter is the chief reason for the adoption of this mode of design.*

[BOTTOM] *The proportion of the mats defines the room spaces and forms the basis of all dimensioning within the building, of heights as well as plan sizes, thus, the height of the lintel is fixed, and the proportions of the sliding doors which form the partitions and outer walls. Compare this conception of integration with the Greek and Georgian.*

[MIDDLE] *Plan of Kyoto. Integration extended to comprehend the planning of the complete town. There have been contemporary proposals to extend the conception of dimensional co-ordination to include city planning and layout as well as the layout of buildings. Such a plan as the one depicted indicates that the proposal is not utopian as it might appear at first sight, although there are objections on topographical grounds. It will probably prove a sufficiently formidable task in the first instance to apply co-ordination only to buildings.*





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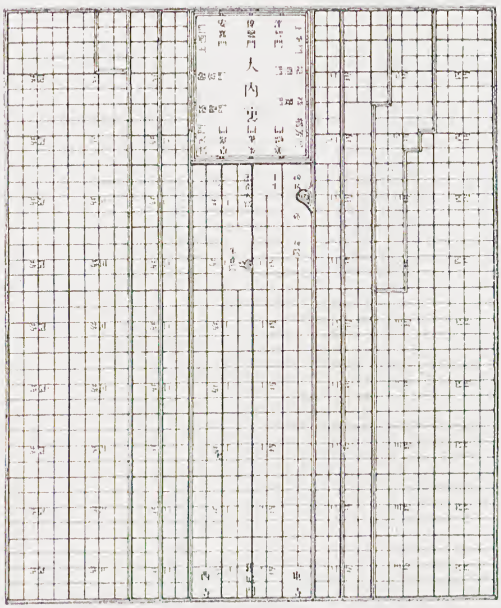

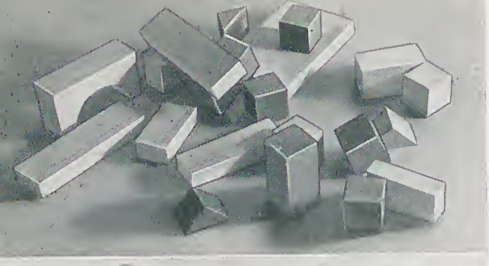

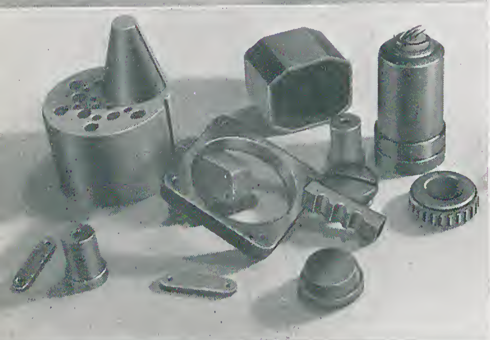

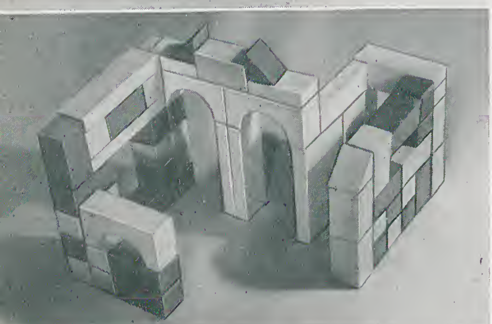

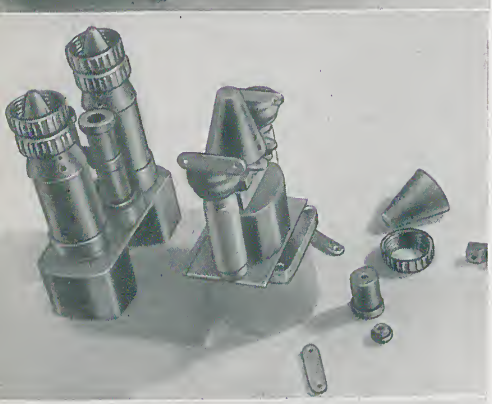

It is realised that this statement could easily be reversed. The balance of political power at the moment is such that one or two countries are in a position to impose their will on all the rest of the world and we might get the super-position of our measures on those of other nations. This is worth noting, however unlikely it is as a contingency, the real point at issue being the emergence of an acceptable international standard to which all can subscribe.

Taut, it will be remembered, thought the Japanese, who are a smaller race than we are, had made an error in standardising on the Tokio standard of 6 ft. × 3 ft. rather than on the more liberal Kyoto standard of 6 ft. 6 in. ×3 ft. 3 in. It would seem that Henry VII made an even more fatal historic error in standardising on the English yard of 36 in. in place of the 40-in. ell. If he had standardised on the 40-in. ell we should not have this fatal divergence to-day between the metre (39·37 in.) and the yard, but would already have achieved an international standard of measure.

Development of the modular conception

There appears to be no extant history on the development of contemporary thought on dimensional co-ordination in building. Clearly, such a consummate example of repetitive building as the Crystal Palace had already posed the problem. The Crystal Palace was based fundamentally upon the maximum size of a pane of glass that could be produced at the time—49 in. × 12 in. Around this basis all the dimensions of the structure were formed.

[OPPOSITE] *The Principles of Modular Design: We show a set of child's bricks* [TOP], *ordinary simple bricks such as all children know how to use. We show a second set of children's bricks* [SECOND DOWN], *purchased from the same counter, a much more exciting set, of strange and novel shapes. The difference between these two sets of bricks is that the first set is modular in conception, the other is not. Now look at the third and fourth down photographs; we have tried to build with our bricks. With the simple modular bricks it is easy to build up walls, we can achieve a recognisable building* [THIRD DOWN], *but with the exciting non-modular bricks the only sort of building we can achieve is a simulation in the solid of the church of Basil Blajenny in the Red Square at Moscow* [FOURTH DOWN]. *These bricks, of course, represent building components and our demonstration is devised to show that, however interesting as individual exhibits, unco-ordinated elements are useless to build with. These non-modular bricks can only be built into the structure by using a matrix (plasticene) into which they can be individually embedded so that they do not jostle each other* [BOTTOM].

Our existing standard building elements are mainly non-modular, they too cannot be built into the structure without the aid of a matrix. Brickwork is the matrix commonly used, but with the advent of prefabricated methods of building a matrix will no longer be available. Where there is no matrix we are compelled to co-ordinate our standards.

In all structures in which repetitive elements are used a dimensional standard is implicit. This, however, is only the first stage. It was many years before the conception of a common dimensional standard for all buildings gained credence. The architect Walter Gropius, in Germany, was one of the first to see the need for this next step in the development of prefabricated parts. At the experimental Siedlung Am Weissenhof at Stuttgart in 1927 he built a house with a steel frame, the plan of which was based on a 3 ft. 6 in. square grid (1·06 metres), and which was an exposition of the theory that prefabricated elements needed a universal planning grid for their successful and economical use.

Many prefabricated systems of building had their planning based on grid design, it was a natural result of this form of construction, but the real theorist of the movement was Albert Farwell Bemis, an American engineer who had devoted his life to a study of the rationalisation of housing technique. In the third volume of his triology, *The Evolving House*, he put forward the conception of a universal cubic module of size—an altogether revolutionary step forward in building thought. To quote Bemis himself: "*These two main principles of mass production—uniformity of cross-section at right angles to length, and repetitive features positioned along the 'length' according to a stated gauge—are not two parallel lines of theoretical proposition. They meet in a finite point. If the uniform cross-section and the gauge are to be applicable to three dimensions, a cube is necessarily defined; the cross-section is a square. One interchangeable unit of measure is found only in a cube.*" The module he adopted was 4 in., the largest module for which general acceptance could be hoped.

Bemis's conception was that the current dimensional measures were insufficient to overcome the anarchic condition prevailing in the building trade. The inch, the foot, the yard, all may be used as modules, and all are by someone or other, but the scale is too loose to provide the required focus. Four inches was decided upon because it fitted well with existing American building products, 4 in. × 2 in. framing in timber at 16 in. centres was common practice, the American brick was roughly 8 in. × 4 in. and rising 3 courses to 8 in. The basis was already laid.

Bemis's book came out in 1936. In 1939 the American Standards Association, with the sponsorship of the American Institute of Architects and The Producers Council authorised *A.S.A. Project A.62* with the following terms of reference:

(A) The development of a basis for the co-ordination of dimensions of building materials and equipment, and the correlation of building plans and details with such dimensions.

(B) Recommendation of sizes and dimensions as standards suitable for dimensional correlation.

A.62 was published in 1941 and it recommended the acceptance of the 4-in. cubic module as the basis for co-ordination of sizes in the building industry. Since then several standards for materials have been issued based on the 4-in. module and it is the intention to add to these standards from time to time until a complete repertoire of products, all based on the 4-in. modular increment, is built up. Acceptance of the modular increment is optional, individual industries decide themselves whether to come on to the grid but once such a grid begins to snowball it is obviously advantageous to each industry to be on it. It is to be expected that as new dimensional standards for products are formulated they will almost all accept the common 4-in. basis. To date, the following products have been, or are being, standardised to modular dimensions: bricks, tiles, concrete and glass blocks, wood doors and windows and steel windows.

It will be clear that 4 in. as a co-ordinating basis is admirable for units of small size. Bricks and clay, or concrete tiles or blocks can readily be co-ordinated one with the other on a 4-in. grid. When it comes to formulating a standard size for products which are several feet square the advantages of the module are not so apparent.

Wallboards are at present produced in lengths from 6 ft. to 16 ft. rising in increments of a foot, and in widths of 2 ft. to 6 ft., rising in increments of a foot. These are already modular sizes but for the absence of a suitable joint allowance. Corrugated sheets are of lengths 4 ft. to 10 ft. rising in 6-inch increments, and widths of 2 ft. Since they lap, the width is hardly modular, but could easily be made so. The 6-inch increments could be made 12-inch increments and the sizes would again be modular, in fact the largest common module of these two ranges of products would then be, not 4 in., but 1 ft.

If now we were to introduce windows at, let us say, 2 ft. 8 in. widths and 4 ft. 4 in. heights, we should have a modular series which was nevertheless quite out of keeping with other products in the same range of size and which could not be built in with

them without cutting. The postulation of a 4-in. module does not solve our problem with the large-scale elements at all. We have to lay down the additional principle that the module must be in suitable scale with the elements for which it is required. Elements about 3 ft. wide should conform to a module of about 3 ft. We have, thus, got to consider the conception of a two-stage modular system, which incorporates a smaller module within a larger module, to which it will bear some direct relation.

The Japanese module varied from 6 ft. × 3 ft. to 6 ft. 8 in. × 3 ft. 4 in., according to the locality and importance of the building, buildings for the use of the Emperor being laid out on a 7 ft. × 3 ft. 6 in. grid, to give the requisite nobility to the structure. This module, it will be remembered, was established because it was most suitable to the size and needs of human beings and this is always the overriding consideration. It is expected that a module of this order will, in fact, be most suitable as a superimposition on top of the smaller module. It tallies roughly with the yard and the metre, basic units of length.

We have already pointed out the inadequacy of the English yard as a basic unit. It cannot be considered for the module since it gives inadequate lintel heights (6 ft.), bed lengths, corridor and stair widths, and so on. Those who have tried to plan on a yard grid find it much too cramping. We are left with the metre (39·37 in.) or its nearest suitable British equivalent 3 ft. 4 in. (40 in.) which give us basic planning dimensions which are in good scale with human needs. Anything larger than a metre tends to be on the lavish side, anything smaller is too cramped.

There are thus two feasible and almost identical modular systems:

10 cm.	:	1 metre
4 in.	:	40 in.

If we discuss the matter on super-national grounds it is because the modular conception ought, in the first place, to be advanced at the international level. The futility of advising a national module when trade has already overstepped the national limits will not need arguing.

In the States they have concentrated solely upon absorbing the small module. In so far as larger units have been standardised they have tended to conform with pre-modular timber stud spacings of 1 ft. 4 in., which gave a convenient 4-ft. unit with four studs. There has been no official recognition or even discussion of the

need for a larger superimposed module, except an official brochure which developed modular planning on a 1 ft. 4 in. basis but without going into the structural aspect, other than to remark that 1 ft. 4 in. seemed a suitable module in view of its common use for stud spacing. In 1943, however, Walter Gropius and Conrad Wachsman produced a design for the General Panel Corporation of New York under the name of Packaged Buildings, based upon a cubic module of 3 ft. 4 in. The module was developed around a novel four-way joint which enabled panels to be centred on a grid and was applied equally to height as well as on plan. A standard series of panels, each 3 modules $\times 1$ module, could be fitted together in a variety of ways to form the structural walls, floors and roof, and the modularity of the conception was maintained in the staircase and other details of the house. This is the only modular structure yet developed for the market. We quote from the Architectural Record on the merits of this system: "*For practical reasons a module of 3 ft. 4 in. was chosen, as it is conveniently related to the standard bed dimensions (two modules) and a reasonably sized bathroom. It is also a convenient dimension for planning stairs, doors and window openings. Furthermore, panels of that width can easily be handled by one man.*"

Once more, and we do not mind reiterating, human scale rather than structural requirements is cited as the main justification for the size adopted.

In Great Britain we find that our dimensional system is based, not upon timber scantlings, but upon bricks. They were fortunate in the States to have, ready to hand, bricks which agreed with timber scantlings. Here, unluckily, they did not. The brick is based on a dimension of 3 in., timber on 2 in.

As the brick is at present our predominant building material, it is not surprising to find that our standard conception, in so far as it has any base, leans toward 3 in. This statement needs qualifying, for a recent analysis of some hundred or so standard dimensions to discover whether there was, in fact, a predominance in favour of 3 in. as against 4 in., resulted in a nearly equal balance, 3 in. just making it. This is of itself not the point. The important thing is that we have launched our new post-war standards upon a general dimensional basis of 1 ft. 9 in., a multiple of seven times 3 in., and 3 ft. 6 in., a multiple of fourteen times 3 in. This is not to say that there has been any attempt to develop dimensional coordination upon these dimensions, there has not, but it does mean

that if dimensional co-ordination were contemplated it would involve rather less disturbance of existing standards to introduce it in this country on a basis of 3 in., rather than the American 4 in. We are, in fact, in some danger, if dimensional co-ordination is ultimately adopted here, of taking the easiest immediate solution and plunging for the modular system of 3 in.–3 ft. 6 in. This must be faced, it will be necessary to combat the tendency at all hazards, for it would be a fateful decision. Let us be quite clear; there is nothing wrong in the abstract with 3 in. as against 4 in. or 10 cm., and 3 ft. 6 in. is nearly as convenient a size in itself as 3 ft. 4 in. or 1 metre. 3 in. $\times$ 14 in. =42 in. is not, however, a rational basis for universal co-ordination; it divides up into halves only: 3 in. $\times$ 7 in. =21 in., and all the figures are messy. Simplicity of nomenclature in measures is very important, as the success of the metric system has demonstrated. Such a module would always be an insular one, we could not expect either the Continent, the United States, or even our own Dominions to adopt it, and we should ultimately be in a helpless position in regard to exports to all these countries.

The Dominions, Canada and Australia particularly, will ultimately expect to import a lot of American materials and these materials, as we have seen, will certainly be based on a 4-in. modular increment. They could not reasonably be asked at the same time to import materials from this country based upon a 3-in. increment.

The metric countries have not yet got around to the contemplation of establishing dimensional co-ordination. The idea of the module has, indeed, been discussed tentatively and unofficially and demonstrated in individual buildings, the recent exhibition of French prefabrication indicating that the modular conception had taken a good hold there. The ground is almost virgin. Nevertheless, it is unthinkable that when they do get themselves organised, these countries will adopt any other than a modular system based upon metric sizes. It is hardly to be thought, in fact, that they will adopt any other modular system than the ready-made one of 10 cm.–1 metre, which so nearly agrees with that of the United States.

We have thus to face a chaotic position with at least three rival dimensional systems competing against each other for supremacy and at the same time restricting the possibility of developing international trade.

Virtually Britain is isolated, she is crushed between the rival American standards and metric standards.

We are, of course, looking at this from a long-term viewpoint. Immediately there is no danger that the metric producing countries will be in a position to compete with either Great Britain or America. Knowing this, an attitude seems to have arisen among our producers that anything will sell during the next ten years, so why worry our heads about fancy schemes of co-ordination? Such short-term opportunism in whatever sphere it is manifested is fatal to our ultimate interests.

We are faced with a situation on the Continent of Europe where the housing shortage is acute, where production has largely broken down and where political and racial barriers are in confusion. To bring houses to the de-housed people of Europe implies an effort of co-ordination on the biggest scale that can be contemplated. As in this country, the utilisation of all traditional sources of building will leave a huge gap to be filled by other methods, other methods being various forms of prefabrication. Having regard to the multifarious and dispersed producing centres and the equally multifarious countries and places where building is required, the problem can only be solved on an adequate scale if a programme involving rigid standardisation and co-ordination of parts is set in motion.

Consider the chaos that will result if each country adopts its own standards. Luxemburg, a small exporting unit, might decide on certain sizes for materials, its neighbours, Lorraine, Belgium, the Ruhr, on other sizes. The materials being prefabricated into units of different dimension. The Americans import articles based upon their own non-metric standards, we do the same, based upon yet different standards to the Americans. None of the articles are interchangeable and colossal stocks of each unit have to be maintained all over Europe. The wastage of such a system is prodigious and not to be contemplated.

Similar problems had to be faced in wartime due to the lack of co-ordination of parts, a similar enormous waste of energy was involved in the maintenance of stocks of each non-interchangeable part in each war theatre. It was said of the sten gun that one of its great advantages was that it would use any type of 9 mm. ammunition produced by any of the belligerents. The advantage of standardisation of this order will not need stressing to service men.

There existed in U.N.R.R.A. an organisation in being which, covering as it did virtually the whole of Europe, could have organised the requisite co-ordination of building elements and production needed for Europe's rehousing.

Now, after the demise of U.N.R.R.A., U.N.O. itself could do it, if it were prepared to cut across the political barriers that have arisen. The job is to organise the production in various countries of like parts to like dimensions, so that they are interchangeable; a given part produced in the Ruhr would be identical with a similar part produced in Italy, Polish Silesia or Czechoslovakia. The amount of stock required would be reduced a hundredfold, the rate of building expedited. The basis for this would be modular co-ordination, the basis for co-ordination would be a 10 cm.–1 metre cubic modular grid.

It will be remembered that the preliminary rehousing will be technically an austerity effort. Buildings will be simple and standardised, a problem similar to, but bigger in scale than, the wartime hutment programme in this country or the U.S. Defense Housing projects.

Experience in co-ordination on big simple programmes has already been gained. In this country wartime hutments were first produced as specialised private ventures, they were non-interchangeable. The chaos that resulted, the difficulties of transport, of obtaining the necessary specialised parts, of maintaining the requisite stocks, of detailing all the different units, of gaining experience in the special erection problems of each type, ultimately led to the production of an official standard framework, the M.O.W. hut, which was used universally with an infilling of varied but standardised panels. The solution was drastic but effective. In the States, a similar beginning was made with the ready-to-hand specialised ventures of private entrepreneures and led ultimately to the production of standardised panel sections based upon the 4-in. module.

The Italian Army, even prior to the war, had evolved a method of prefabricating standardised army buildings based on storey height panels 1 metre wide and 3 metres high, with floor and roof sections of the same modular dimensions, to build up into huts of one or two standard span types. This was done to facilitate manufacture of parts in various scattered and unrelated plants

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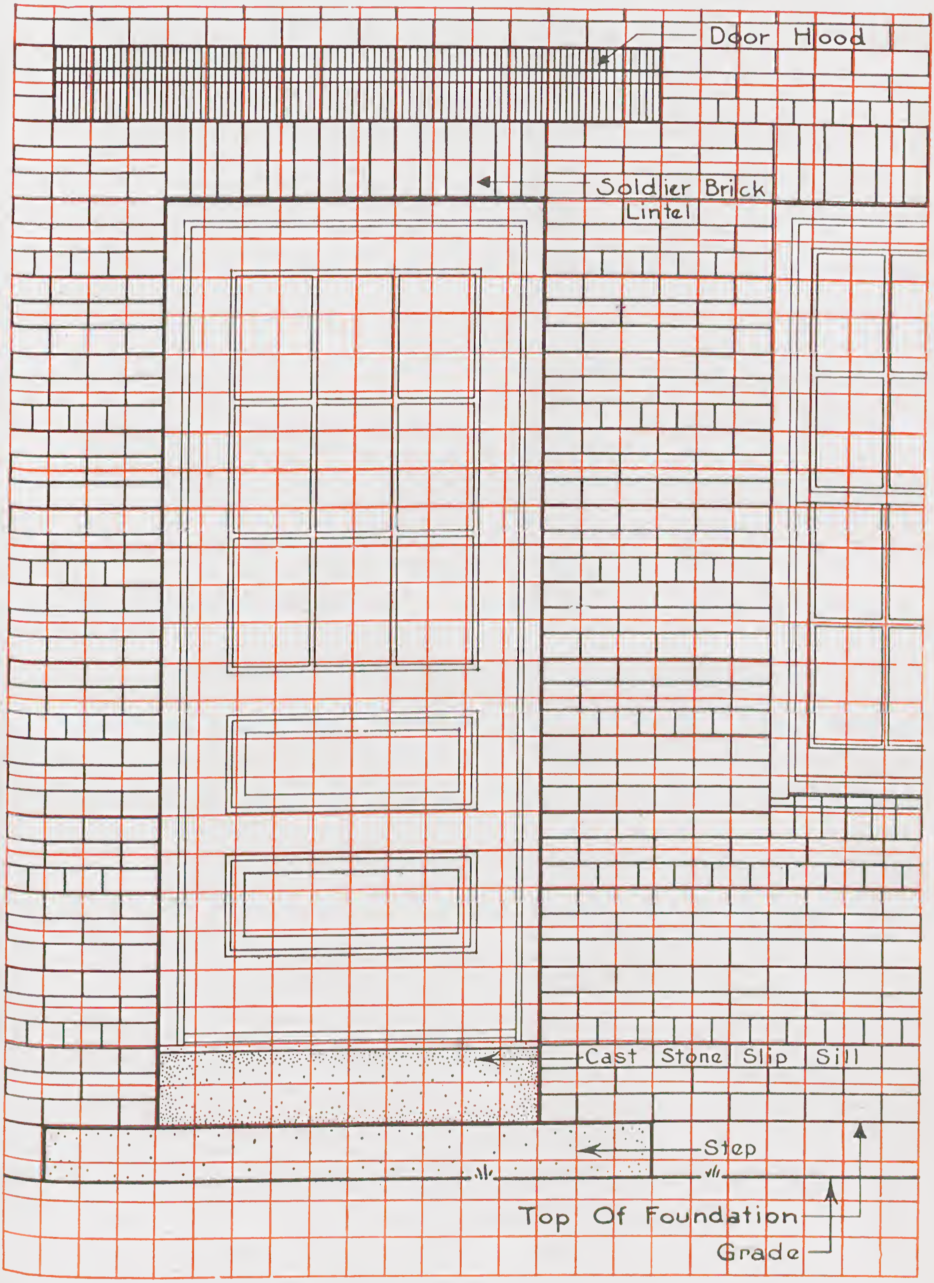
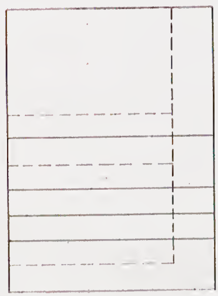
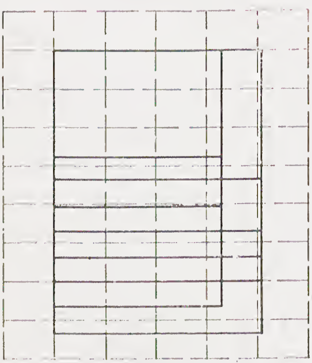
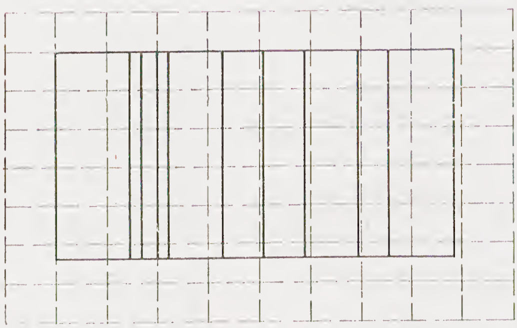
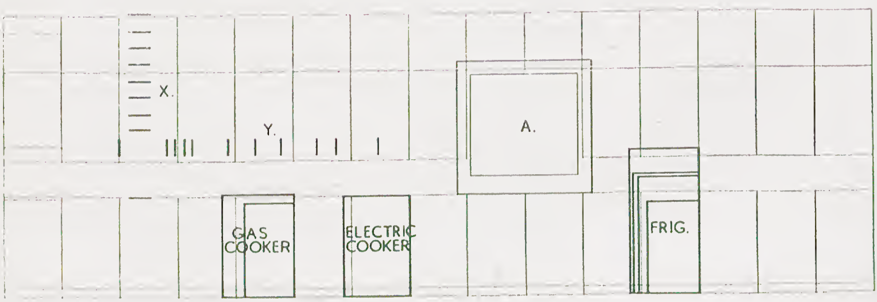
A.S.A. Project A.62. Designing on a modular grid.


Door Hood
Soldier Brick
Lintel
Cast Stone Slip Sill
Step
Top Of Foundation
Grade








X.
Y.
A.
GAS COOKER
ELECTRIC COOKER
FRIG.

and their ultimate fitting when they were brought together on a site which might be hundreds of miles distant.

On this reasoning, it is conceivable that this country (and America) will be called upon to supply vast quantities of prefabricated elements for housing based upon a metric module and that our manufacturers will shortly be faced with the problem of producing a similar article at the same time to two dimensional concepts, one for export, one for internal consumption. This is the contretemps that the introduction of a universally recognised form for building dimensions is designed to avoid.

There are those who imagine that inter-state trade in building

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An analysis of some British Standards.
In this series of diagrams we have taken a few of the latest British Standards and related them to each other dimensionally. The process is absorbing, if depressing, and can be carried on and on indefinitely. [TOP LEFT] *We show the horizontal range of steel casement sizes (B.S. 990: 1945) and their relation to brick dimensions (shown by dotted lines)—there is, of course, no relation.* [TOP RIGHT] *We show the corresponding series of timber casement sizes (B.S. 644: 1944) which are dimensioned uniformly ½ in. short of the corresponding brick dimensions, to admit of fixing. This is an effort at co-ordination.* [LEFT, SECOND DOWN] *We relate the timber and steel casements (shown dotted) considered above, to each other, again there is no relation.* [RIGHT, SECOND DOWN] *We relate the vertical sizes of corresponding timber and steel casements and, once more, we find there is no relation. This lack of relation between the two sets of windows means that, once the decision has been made to use one type of window, it cannot be revised at a later stage of the job, without altering all the drawings, and, once the openings are formed in the building, the matter is settled irrevocably.* [THIRD DOWN, LEFT AND RIGHT] *Here we have taken the liberty of setting the vertical and horizontal window dimensions of the above on to a grid representing the fixing sizes for standard clay blocks (12 in. × 9 in.) (B.S. 1190: 1944) and, once more, we find complete lack of co-ordination. Concrete blocks, (B.S. 834: 1944,), are 18 in. × 9 in. and fix to a grid one and a half times that shown, so that there is no correlation here either. These blocks cannot so readily be chopped about as can brickwork and the matter is becoming serious, for the windows will not fit without the use of specials or of elaborate cutting. Finally,* [BOTTOM], *we introduce the semi-co-ordinated kitchen fitments (B.S. 1195: 1944), based roughly on a 1 ft. 9 in. grid, and relate them to window sizes, horizontal and vertical. The short, thick lines at X and Y indicate vertical and horizontal window dimensions, which bear no relation to the kitchen fittings. It may be argued that they do not need to, but consider our attempt at A to introduce a window into the range of cupboards, assuming that the cupboards are ranged along an external wall. The smaller steel casement, 3 ft. 0½ in. × 3 ft. 3¼ in. will fit snugly into the space left by the omission of two units, but the wood casement is too wide; it is also too high. One would have to leave out three units together with the dead storage over to accommodate a two-light timber casement. Now consider the use of timber casements set, as would be natural, centrally in the spaces provided. The carefully thought out co-ordination of casement with brick size has to be discarded because the casements, for internal appearance, are now set at centres which are multiples of 1 ft. 9 in., which is not a brick dimension. Even co-ordination, therefore, breaks down if it is based upon several unrelated roots. The odd black rectangles interspersed with the cupboard units indicate B.S. sizes for such items as gas and electric cookers and refrigerators. After what we have said they need no further comment other than to say that the lack of co-ordination extends to the plan depths of the items as well as the elevations.*

is not highly developed and that, therefore, the problem, as posed here, is somewhat academic. These people think always in terms of bricks. The newer building industries, the electrical trade, wall-board manufacturers, the plastics trade, iron and steel and non-ferrous metal products, even such heavy and relatively cheap materials like tiles, export in enormous quantities. The annihilation of distance by improved transport methods means yet more international exchange of products. The problem is not academic, it is real and pressing and should be made a first priority for study by an International Standardising Body.

The application of the modular increment

In practice the modular system is established in two ways:

(*a*) by the laying down of appropriate modular grids in the necessary scales, and

(*b*) by the development of fixing details.

The standard may be fixed merely by a brief document giving effect to (*a*) above, but it will not be really effective until several products have been brought into line with grid sizes and their co-ordinated fixing details worked out. We give one or two diagrammatic examples of such details.

The modular increment of 4 in. in all three planes implies that products which are designed to build up in multiples of the module size will be made rather less than the full module to allow for the width of the joint. Thus, the product plus one joint is equal to the full modular size. Modular standards are developed, therefore, by defining the fixing details for the product.

Thus, co-ordination of masonry to masonry details requires bigger joint allowances than metal windows to wood jambs. It is for the manufacturer to work out the appropriate fixing allowances for his product and he will arrange the manufactured dimensions of his product accordingly. An article sold as 4 in. × 4 in. nominal would measure slightly less than this according to the fixing allowances that have been adopted but the designer need not worry his head as to the actual sizes, he lays out his work on the grid. For that matter, the standardising of fixing details will ultimately reduce his detailing work, for it will be sufficient in many cases to issue standard fixing details to the job in the knowledge that the fixing detail of one product will dovetail with that for another without any additional paper work.

One problem always worries students of co-ordination—to

what extent are thicknesses of materials, partitions and walls allowed for in the method?

If the details of Packaged Buildings are examined it will be seen that all the units join on the grid centre lines by the aid of a very ingenious fixing detail. This is the simplest method of working to a grid but it is of only limited application. In almost all normal building, allowances for wall thicknesses will have to be made. Such allowances can only be made where wall thicknesses are themselves of modular size. No difficulties arise with the small 4-in. module and the diagrams given are sufficient to indicate the methods of absorbing modular wall thicknesses into the conception.

Where, however, a two-stage module is used, wall thicknesses will create a difficulty. The wall thickness will, as before, be some multiple of the smaller module, whereas the elements to clad the walls will probably be a multiple of the larger module. The conception of "tolerance" or allowance sizes has been introduced to overcome the difficulty, whereby it is possible to allow for one or two common thicknesses of wall without resorting to specials. This, too, will be made clear by referring to the diagram. Briefly, if we are using the 10 cm.–1 metre modular grid we can allow, without much difficulty, for two thicknesses of wall, 10 cm. and 20 cm.

The modular product, nominally 1 metre in size, will, in addition, have to be made in sizes 10 cm. $\pm$ the modular dimension. Thus the product will have to be made in sizes of 90 cm., 100 cm. and 110 cm. nominal.

The modular grid will be put out, therefore, in the form indicated in the diagram, where the small squares represent the lesser of the two modules, the thick lines the primary module, and the dotted lines the tolerance lines.

The complete range of tolerances possible, within the limit of the red lines, for each basic standard is 14, but it is improbable that all these will be required in practice. The manufacturer will have to decide, according to the nature of his product, on the minimum range which will adequately cope with normal practice, and the designer, knowing the range of tolerances produced, will limit himself accordingly.

. . . .

Project A.62 sets out the following advantages and economies that might be expected to accrue from the development of co-ordination:

Improvements in Present Standards

Elimination of duplicating or overlapping stock sizes.

Nation-wide standards instead of sizes fixed by local customs in different sections of the country.

The solution of problems of standardisation which various producing industries are now trying to solve.

A stimulated demand for stock sizes in preference to special sizes, as a result of their more convenient use and economical field erection.

New Applications of Standardisation

Lower costs of manufacturing against stock as compared with the customary manufacture of special details and sizes.

Improved precision and uniformity of quality that result from improved manufacturing processes.

A market for new building materials where the cost of special detailing or field cutting would be prohibitive.

Standard assembly details help the manufacturer to control the application of his products and to avoid complaints that arise from faulty installation.

Benefits of Co-ordination for the Architect

A simplified method of making his building layout which will reduce drafting time.

The possibility of changing specifications and substituting alternate materials and constructions without redrawing his layout.

The elimination of the designing and the repetitive redrawing of structural assembly details.

The better availability of many building products through their improved standardisation with a consequent simplification in specifications.

The replacing of special details by stock items, so that the designing and detailing for these items may be simplified.

Easier supervision of the job as a result of standard building practice.

The unity of design that results from the application of a single dimensional unit, both vertically and horizontally, to the building

structure, openings and finish, and to various exterior features such as garden walls.

Benefits of Co-ordination for the Builder

The improved clarity and accuracy of standard co-ordinated assembly details.

The simplification of estimating which will be made less laborious and more accurate by the elimination of fractional inches and probably by the tabulation of nominal areas.

Lower cost of field erection by the reduction of field cutting and fitting.

The possibility of developing uniform building practice with better control of field operations.

Co-ordination will not interfere with the use of conventional methods of cutting and fitting or special detailing wherever they are preferred.

THE FORMULATION OF A STANDARD

IN 1870, a Standards Department of the Board of Trade was developed to supervise weights and measures and in 1900 the National Physical Laboratory was formed at Teddington for the purpose, among others, of testing and ascertaining standards. Equivalent bodies were founded in other countries, such as the U.S. National Bureau of Standards and, in Germany, the Physikalisch-Technische Reichanstalt which was established in 1887.

In 1901, a Committee was formed under the title Engineering Standards Committee in London, at the instigation of the Institutions of Civil, Mechanical and Electrical Engineers, the Institute of Naval Architects and the Iron and Steel Institute. It was the first body of its kind promoted anywhere in the world to study and engage in the work of standardisation and from the first it had Government encouragement. Its scope in the course of time went beyond the narrow field of engineering standards and its title was changed in 1931 to British Standards Institution, it having been given a Royal Charter two years earlier in 1929. In 1942 it obtained official recognition as the "sole organisation for issue in consultation with any Government, professional or industrial bodies concerned, of standards having a national application".

Other countries followed the lead given by Great Britain, great impetus having been given by the international and urgent demands for materials during the First World War. The American Standards Association, now one of the most forward-looking bodies, was formed in 1918 on very similar lines to our own, that is, it was a federation of trade and professional organisations independent of but with the backing of the Government, several of whose agencies are represented on the governing body.

By 1939 the following twenty-seven countries had national standardising bodies functioning: Argentina, Australia, Belgium, Canada, China, Czechoslovakia, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Italy, Japan, Latvia, Netherlands, New Zealand, Norway, Poland, Roumania, Spain, South Africa, Sweden, Switzerland, U.S.S.R., United States. Those of Japan, Latvia, New Zealand and the U.S.S.R. are

government bodies, whilst the rest follow the organisation of the British body.

Shortly after the outbreak of war the Ministry of Works set up a department under T. S. Tait to study the simplification of standards for wartime needs. This department issued many simplified versions of pre-war standards, such as, for instance, a simplified list of steel casements in wartime. When the Directorate of Post-War Building was set up in 1942, the standards department was absorbed and undertook the wider task of considering building standards for post-war use. The work was entrusted to a Standards Committee formed in August 1942, the members of which were drawn from representative professional, trade and technical bodies together with representatives of the B.S.I., the D.S.I.R., and the Ministry's Codes of Practice Committee, of which more presently. Its terms of reference were thus:

"*To study the application in building of standard plan elements, standard specifications and building components, and methods of prefabrication, with the particular object of ensuring*

(*a*) *economy in the use of material in the post-war period,*
(*b*) *simplified and speedier procedure and construction, and*
(*c*) *wherever possible, improved quality and design.*

To make recommendations for such standards as well as for standards for terminology and consumer requirements, to correct, review and correlate recommended standards put forward by Study Committees of the Directorate of Post-War Building and to draft material for the British Standards Institution and the Codes of Practice Committee of the Ministry of Works, to be used in the promulgation of official British Standards and Codes."

It will be seen that the Committee's terms were primarily to consider standards for the immediate rebuilding period. Short-term measures have taken precedence, therefore, over long-term measures and no attempt has been made to overhaul basic standardising practice. The Committee's work has resulted in a great outflow of new standards and revisions of existing standards which were held to be obsolete, as the following figures indicate:

Number of building standards issued up to Sept. 1939—148.

New or revised British Standards issued from Sept. 1939 to Nov. 1945—146.

New or revised British Standards in process of preparation at Nov. 1945—92.

Total number of recommendations for standards made by the Committee—260.

It will also be observed that the Standards Committee does not itself issue standards. The official standard is issued by the B.S.I under its prerogative of being the only body for the issue of standards.

The Committee issued a First Report in 1944 in which it stated that it had interpreted its terms of reference in the following manner:

(A) Consumer Requirements.

To establish the minimum standards necessary.

(i) To secure that building components are suitable for their purpose, have satisfactory appearance, appropriate length of life and provide efficiently for health, convenience and safety.

(ii) To secure that materials conform to known tests as to composition, and to any relevant physical, mechanical and chemical properties to ensure efficiency in use.

(iii) To form a basis for inspection, testing, comparison and grading of goods.

(B) Producer Requirements.

To establish the minimum standards necessary.

(i) To secure economy in the use of materials, labour, machinery and tools.

(ii) To secure that building elements conform to recommended dimensional standards and types, *permitting of interchangeability* and ready replacement and of a reduction in the multiplicity of types and sizes.

Laudable objectives all, if we exclude "satisfactory appearance" for how can a committee ensure satisfactory appearance except by designing the object? We express ourselves on the subject of design standards later on in this work in no uncertain terms. We also venture to italicise the reference to "*permitting of interchangeability*" for the Committee has, in point of fact, baulked at the provision of a modular system. Its standards do *not* permit of interchangeability, the most notable and easily recognised example being the non-interchangeability of metal and wood casements. This, too, we discuss in another place.

About the same time as the Standards Committee was formed, i.e. in September 1942, the Ministry of Works and Planning (as it then was), in consultation with other Ministries, set up a

parallel body, the Codes of Practice Committee—"*To direct the Preparation of Codes of Practice for civil engineering, public works, building and constructional work.*" This body, too, is formed from representatives of the several interested technical and professional bodies with assessor members culled from the various interested Ministries. It, too, functions more or less independently of Government, the correct description apparently being '*under the ægis of*' the Ministry of Works. If you want to know what that means you must look it up. Unlike the Standards Committee, which is closely linked with B.S.I. and by whom all its results are issued, the Codes of Practice Committee issues its own Reports and its own Codes. Its Codes are not British Standards unless they have been specifically adopted as such by B.S.I. and at present all the Codes issued are intended merely as guides. Moreover, they are put forward as guides to good practice not minimum practice. It will be remembered that the Standards Committee has concerned itself with minimum requirements. Codes of Practice, in fact, are not considered to be strictly a part of the Standards set up, but for our purpose they have to be so regarded. The Committee has issued two reports, the first of which contains an admirable summary of the history and function of codes in building.

Such, then, is the apparatus available in this country at the present time for the promulgation of standards. From the point of view of organisation we are as far advanced as any other country, although the Department of Commerce of the United States Government has had its National Bureau of Standards for many years and the American Standards Association set up its Building Code Correlation Committee as far back as 1935.

The B.S.I. lays down these three principles as its objectives:

(A) That British Standards shall be in accordance with needs of industry and fulfil generally recognised want.

(B) That interest of both producer and consumer shall be considered.

(C) That periodic review shall be undertaken.

These axioms bear out our contention that a standard should only arise against a proved need and that it shall be kept flexible throughout its career. When the need for a given standard has become sufficiently insistent those who require the standard are expected to sponsor it. The B.S.I., working on the above maxims, does not initiate standards itself. It waits until a sponsor comes

along with a proposition for a standard. In this way, a safety valve is formed, arbitrary standards which no one really wants are not likely to be promulgated. The sponsoring body will be one of the constituent members of the B.S.I.

The proposed standard, if it appears to be valid, will then be submitted to a committee embracing not only the particular interest which is urging the standard but all other interests which may be effected by it. Thus, an industrial standard has to be agreed to by producers, consumers, technical and professional bodies. In the words of Sir Percy Ashley, late chairman of B.S.I.,

> "*The promulgation of standards formulated under the ægis of a body wholly independent of any one industry and providing for consultation with other industries, distributors and consumers generally, gives public assurance that a broad and balanced view has been taken, and can secure a good national standard of quality and practice.*"

When agreement is reached the standard receives approval of the B.S.I. as a British Standard and is given a number for ease of recognition, thus: British Standard No. 582 for Asbestos Cement Soil Pipes, for short B.S. No. 582. At one time, in addition to British Standards (B.S.) there were also British Standard Specifications (B.S.S.) which had, however, the same validity. It was found that the distinction between a plain "Standard" and a "Standard Specification" was so hard to draw that the title Specification was abandoned and all British Standards are now designated by the two letters B.S. It is also becoming common practice to mention the date: B.S. No. 1085: 1943, in order to distinguish the latest version from its predecessor. This has the advantage of indicating whether the standard is a new one or has lately been revised and can, therefore, be relied upon to be thoroughly abreast of present-day needs, or whether it is an early standard at the bottom of its efficiency curve. *B.S. Handbook No. 3* gives dates for all the standards it includes.

This is, of course, a bald statement of the case. Each standard may involve months of the most arduous labour and passing backwards and forwards before agreement can be reached. Exceptionally, the standard may be thrown out. We reproduce the detailed process of forming an American Standard on Reinforced Gypsum Concrete as this is not unamusing and serves also to illustrate American procedure, which is basically the same as our own.

"*This was a clean-cut job from start to finish . . . the standard moved on without a hitch and was completed in exceptionally good time. As the first step, the Building Code Correlating Committee recommended to the A.S.A. that a project on this subject be set up, and outlined the scope of the subject. It recommended that the Building Officials' Conference of America and the Gypsum Association be made sponsors. These recommendations being approved by the A.S.A., and upon acceptance by the proposed sponsors, a sectional committee was organised by the sponsoring organisations in co-operation with the A.S.A. and the chairman of the Building Code Correlating Committee. The personnel of the Committee was later approved by the A.S.A. upon recommendation of the Building Code Correlating Committee.*

A tentative draft of the proposed standard was prepared by a drafting committee and circulated to the full committee with a request for comments. An organisation meeting was held at which officers were elected and comments on the tentative draft considered. Changes in the tentative draft that were approved at the meeting were written into a second draft. This was followed by a third draft, incorporating other approved changes and amendments, which was approved by the committee on letter ballot. The proposed standard was then submitted to the Building Code Correlating Committee which referred it to the editorial committee, and to the Advisory Committee on Working Stresses for a review of the recommended working stresses. The Advisory Committee approved the stresses but suggested that certain provisions be reconsidered in the interest of clarification. Following a letter ballot canvass of the committee on the proposed changes a fourth draft, incorporating these changes and certain editorial revisions, was circulated to the committee which voted approval by letter ballot and recommended that the proposed standard be submitted to the A.S.A. for approval as American Standard.

The sponsor organisations endorsed this recommendation and transmitted the proposed standard to the A.S.A., which referred it to the Building Code Correlating Committee for recommendation. Finding that the representation of the various interests concerned was adequate and that a satisfactory consensus had been reached, the Correlating Committee recommended to the A.S.A. that the proposed standard be approved. The recommendation of the Correlating Committee together with a record of the action of the sectional committee was considered favour-

ably by the Standards Council of the A.S.A. and the document was approved as an American Standard."

There you are, all neat and tidy. If difficulties had arisen, it would not have been quite so simple.

The B.S.I. does not instigate standards. It follows that the standards it issues are those which some group or another urgently wants. It also follows that the best organised groups succeed in getting their standards through, and the unorganised groups do not. Thus, whilst there is no danger under this system of our getting a lot of redundant standards, and that is a great point in its favour, there *is* the danger that some sections of the community will not be adequately safeguarded. So far as any given standard is concerned *all* the interested parties are, indeed, represented but those unorganised parties themselves rarely get so far as to sponsor a standard. It is inevitable that there is no overall and constructive policy in this *laissez-faire* method: might is right. The organised producers and distributors generally have their way relative to the unorganised consumers.

In building, where we are surely in need of correlation, the haphazard methods of B.S.I. are entirely inadequate, though they may work well in dealing with a well-organised single industry. Hence the need for a centralised body which can itself instigate standards. It will be realised that though most industrial standards are economic in origin there are needs, vital needs, the standardisation of which does not advantage any particular group. Such a measure is modular co-ordination, the advantages of which are general and long term and not easy to assess, the disadvantages of which are short term, and the measure, consequently, does not get a sponsor in a *laissez-faire* system. Hence the establishment in this country of the Standards Committee and the Codes of Practice Committee of the Ministry of Works and, in America, of the Building Codes Correlating Committee.

The immediate terms of reference of our Standards and Codes committees are of less significance than the fact that for the first time we have two bodies capable of surveying the task as a whole and of initiating policy. For the first time it has become somebody's business to look out for gaps in the lists of standards, to search out new possibilities and to devise standards irrespective of whether any material advantage would accrue. The Codes of Practice Committee have, from the start, worked out a broad policy of codification and have begun to implement it. We have

already been given the preliminary fruits of this codification work, the new functional codes, which benefit nobody except the consumer and which would not otherwise easily have seen the light of day. The Standards Committee, so far, has not undertaken a like task relative to standards. Its work has consisted in ratifying all the main pre-war standards and in introducing a miscellaneous set of new standards with no better policy other than their expediency in relation to immediate post-war needs. Valuable work no doubt, but not the full realisation of a great opportunity.

The argument for a Government agency on standardisation is, therefore, a strong one. Government interference in the standardising machine would not have been necessary if the professional bodies had performed their task thoroughly, if, indeed, they had even grasped their task, for theirs, surely, is the higher function of initiating policy and guarding the public. Our professional bodies have been lax and unimaginative and the Government has, rightly, stepped in. The argument against a Government agency, and it would apply to any body of the type, is that officers whose job is to make standards, under which they themselves do not labour, might easily allow zeal to outstrip necessity and load us with a welter of standards which are not really required. We would question the issue at this juncture of standards for such detailed and irrelevant matters as the method of folding prints when there is still no discernible policy or priorities in standardisation. We see the danger of regulating for the sheer joy of regulating, of introducing ambitious schemes, the working out of which becomes a formalised automatic process divorced from actual needs, of tidying up odd corners merely for the sake of tidiness. The answer to this is in the old B.S.I. motto ". . . shall fulfil a generally recognised want" and, as with other forms of liberty, the price is eternal vigilance. The duty is still laid on the professional bodies to exercise this vigilance on behalf of the community.

At the present time, though there are many standards which have reached international status, there is no broadly based international standardising body. International standards such as 35 mm. and 16 mm. cinema spools have been brought about by agreement between the individual standardising bodies in each country. We have to realise that conscious, deliberate standardisation, as against the gradual outcome of custom and usage, is a very recent development and that the standardising bodies are still very much finding their feet in their own country. We shall

probably be accused of idealism when we suggest that the most urgent task we have to face in the next few years is the setting up of an international standardising body charged with the task of correlating all national standards. Nevertheless, we are at present forging in U.N.E.S.C.O., a technical arm of U.N.O., an admirable instrument for undertaking this vast task, a body of men of technical training charged to look at facts internationally. During the war, the allied powers found it necessary to have inter-allied correlating committees on most of the main supply problems, and it is being suggested that this experience is excellent ground for the building of peace-time correlating committees with a still wider base. It has been estimated that differing standards in the States and Britain for screw threads added at least £28,000,000 to the cost of the war: "Difficulties encountered in lack of interchangeability have run all the way from delays and added production cost in filling lease-lend orders, to the necessity for maintaining vast stocks of duplicating replacement parts in distant war theatres. Hence representatives of Britain, the U.S.A. and Canada got together to thrash out a common basis and this it is felt will be of interest to other countries in the post-war period." Here is just one example of hundreds where international trade between countries demands standardisation at the international level, and this in turn demands an international standardising body or clearing house.

The allied countries carrying over this war-time work into peace have established a United Nations Standards Co-ordinating Committee for the express purpose of bringing about international agreements promulgated by the participating countries in their national standards. To this extent we must qualify our previous assertion that no international body existed. This, at any rate, is a nucleus for such a body, but it cannot get very far until it can override its national constituent bodies, and it will not get anywhere at all until it brings about a unification of international dimensioning.

WAYS IN WHICH STANDARDISATION IS APPLIED

Building standardisation is applied in one of four ways: (*a*) by standards of custom and usage; (*b*) by a bylaw or other statutory enactment; (*c*) by a code of practice; (*d*) by a direct standard.

Direct standards are issued in this country by the British Standards Institution, and they are, in themselves, non-mandatory. They may be, and are, made mandatory by incorporation in some statutory enactment.

Codes of practice are used where strict and rigid standardisation is not applicable but where regulation, or control, or guidance, is felt to be needed. They are also used as a preliminary stage in the formulation of requirements that will ultimately be made into British Standards or mandatory enactments.

The bylaw is the traditional means of controlling building practice. Unlike the above, the bylaw is always mandatory and it may incorporate B.S. or codes.

Regulation by Bylaw and Mandatory Enactment

The functions of these means of standardisation overlap a good deal. They appear side by side because the growth of our building regulations has been empirical. Building regulations date back from earliest times. T. F. Reddaway, in his book *The Rebuilding of London after the Great Fire*, says:

> "*Building regulations of various kinds had existed in London for centuries* [he is writing of the year 1666]. *The Stuarts had intensified them without much success.*"

After the fire wooden buildings were prohibited in the City of London and other elaborate details of the types of buildings that were to be allowed were set down.

A walk through the suburbs of any of our large industrial towns must impress the feeling that standardisation has been applied for very many years in the formulation of these drab, weary zones. All the houses in a whole street are identical; in a whole area they will differ only in superficial particulars. The date at which they

were built is stamped indelibly on their layout, and yet we know that the house, as such, has never been standardised.

The Public Health Acts which give rise to these results, and whose sanitary provisions were wholly admirable in themselves, only purported to lay down minimum limits: provision for light and air, room heights and sizes, ventilation openings, building lines, the area of site that could be built over, and so on. Within these broad limits a thousand different types of house could have been erected, the provisions of the Acts were apparently harmless.

But the very reason for the imposition of the restrictions on free building was because house building was in the hands of unscrupulous builders who cared not a jot for giving the people good houses, but were only interested in giving them the minimum they could get away with. They continued this attitude under the Public Health Acts, with whose provisions they were forced to comply, and they complied strictly to the letter of the law. In every minute particular the new houses were built down to the minimum. When a builder had found the minimum structure that would pass the regulations he went on building the same unit indefinitely, until a further edition of the Acts involved him in some alteration to his design, whereupon, a new model in equal numbers would oust the old. Here we had standardisation with a vengeance, a standardisation that required no B.S. number to ensure it, standardisation that was far from the minds of the legislators, who, in framing their codes, were simply trying by decree to raise the quality of house building. As the minima were raised so the results in practice became more bearable, considered as environment, but even to-day we still suffer from the same blight. Wherever a regulation is laid down as a minimum it rapidly becomes a norm and it results, thereby, in a standardisation that was not intended. All sorts of varying formulas have this result. Public Health Act housing gave way, in the inter-war years, to Town Planning Act housing which, at its higher material level, was just as monotonous and wearying to the spirit. The formula

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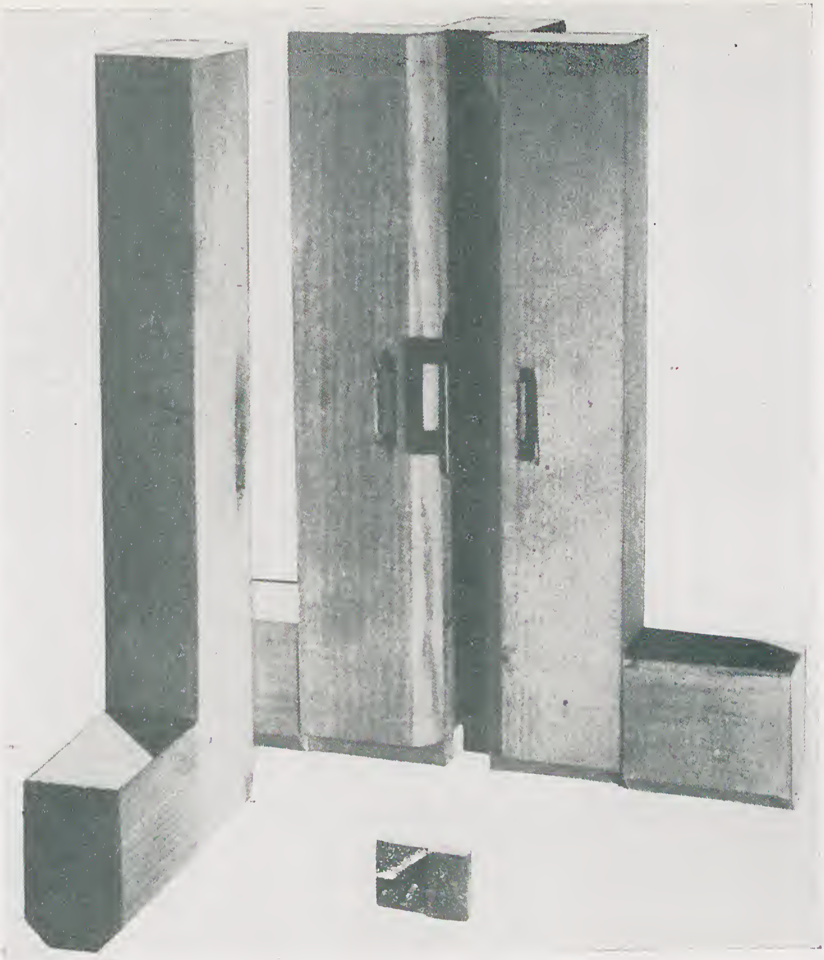
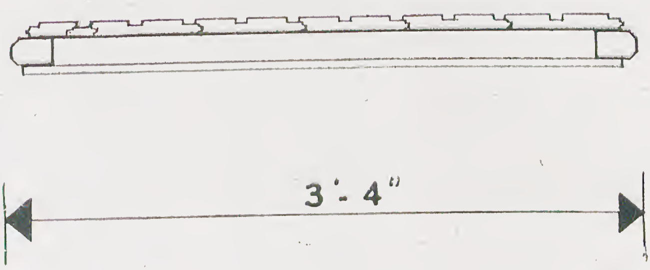
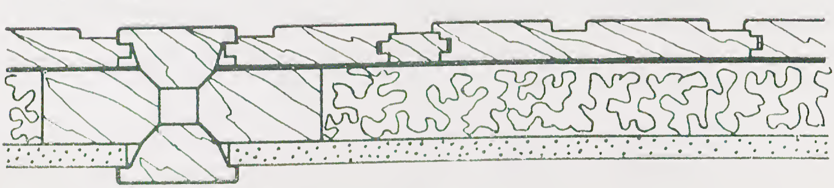
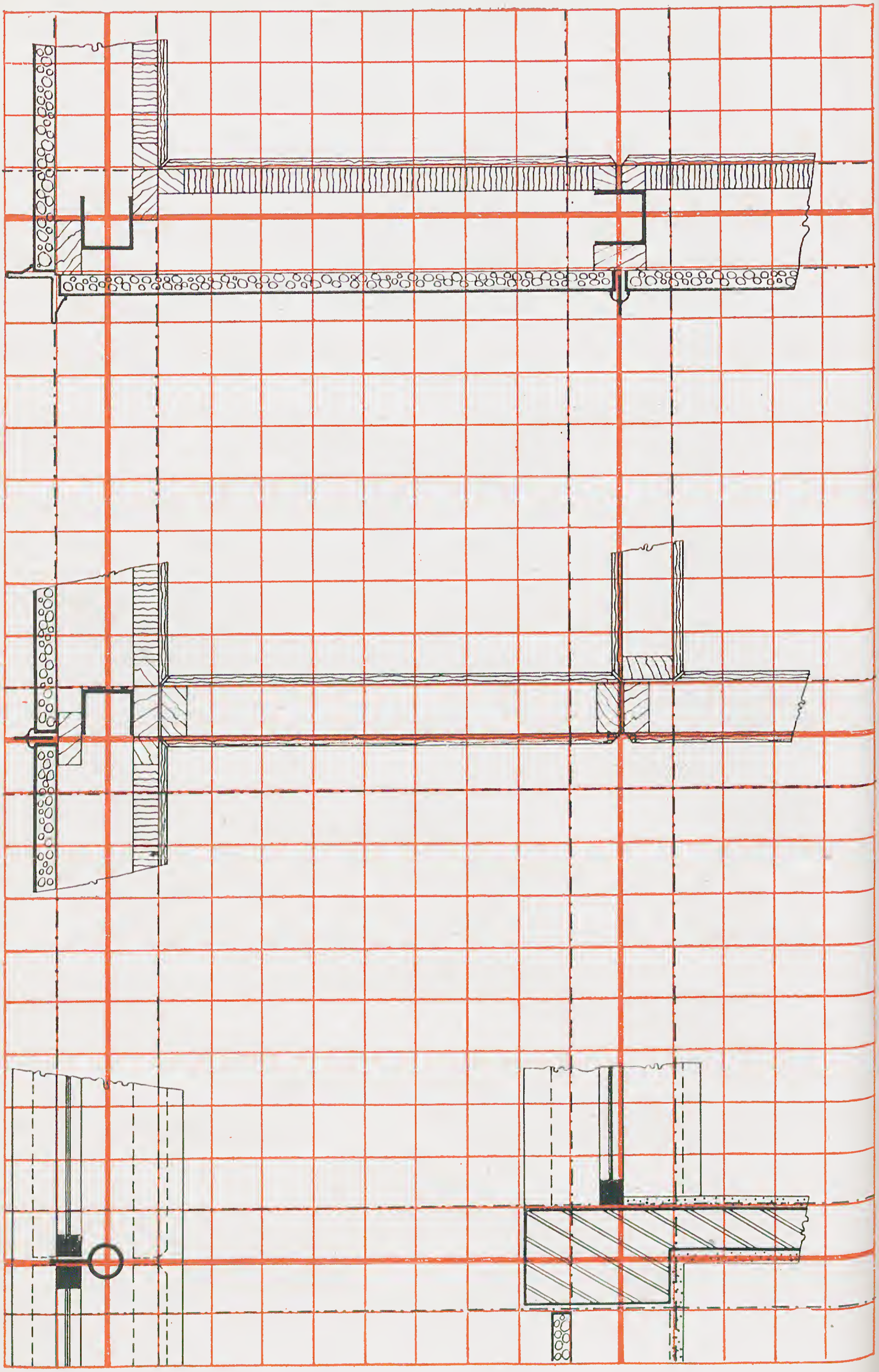
Packaged Buildings.

[OPPOSITE] *Packaged Building Corp. devised a panel system which worked to a modular grid of 3 ft. 4 in. and which had an ingenious joint arrangement which enabled the panels to join centrally on the grid and which obviated difficulties of allowing for wall thicknesses. Whereas this method can be made to work in the case of an individual system of building, it is not of very general application and the method of using "tolerance" sizes has to be resorted to in designing products for stock.*




3'- 4"





"twelve houses to the acre" became a rigid standard, so rigid as to be almost an official commandment.

It was only one of many unintentional contributions to sterility. The post-war years will almost certainly be stamped with the indelible standardisation of the 900-ft. sup. house, it will create its own environmental epoch for our historians.

The results we have just been discussing could be described as standards of consent, of custom, of regulation. They come under the general category of design standards. They are, without exception, to be avoided wherever possible. They arise, as do the regulations that cause them, because of the predatory nature of our civilisation. In a society in which gain was not the main motive of endeavour we should not expect them to arise at all and the regulations consequent would appear merely in the form of desirable codes of practice. They arise, moreover, without any specific standard being laid down. It may be observed that it is not sufficient to lay down a standard, or code, or bylaw. There must also be present the will and the understanding to use it intelligently. Though the sanitary bylaws were admirable in conception, they were applied, in practice, by people who sabotaged their intention and who were content to give effect to the letter, but not the spirit of the law.

Standards of function and design, or codes, can only be effective where they are to be used by a body of men who will apply them in the true spirit in which they are framed. It is quite impossible to so frame such standards that their value and meaning cannot be aborted by unscrupulous individuals who care nothing

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[OPPOSITE] *Application of a two-stage modular grid with "tolerance" sizes. The two-stage grid is formulated with the major grid in heavy lines and the minor grid in a lightly drawn intermediate pattern. The "tolerance" lines are dotted in on either side of the principal grid lines and fall over the lines of the minor grid. Thus, if we are using the 10 cm.–1 metre modular system, the heavy lines represent the metre spacing and this is divided into ten portions each of 10 cm., the "tolerance" lines are spaced 10 cm. on either side of the metre grid. The drawing indicates how the "tolerance" sizes are used to accommodate wall thicknesses of 10 or 20 cm. nominal without resort to specials, it being necessary to have on hand stock sizes of the full modular width, the modular width plus 10 cm., and the modular width minus 10 cm. Exceptionally, a product might be required the full modular width plus or minus 20 cm., but it is hardly likely that so many standard variants will be available, specials would be needed in these cases. This drawing is diagrammatic only but the reference to the A.62 diagrams, facing page 40 and page 64 will indicate how the detailing is done. The A.62 diagrams are dealing with small elements on a small modular grid. The two-stage grid is needed to take care of larger building elements, such as wallboard units or units for exterior cladding, or prefabricated flooring sections.*

for the well being of the community which the standard has been designed to serve.

We should ask ourselves if we have reached such a level of cultural attainment that codes of design and even purely functional codes are likely to be intelligently handled. Frankly, we doubt it. The mass of design codes relating to architecture and town planning are having a deleterious rather than a good effect. The most notable example of the misuse of such a code is to be found in experience with the design regulations in regard to external appearance of buildings, embodied in Town Planning schemes. The Ruislip and the Chipperfield cases may relevantly be quoted as examples, where architects of the highest standing and integrity had their designs turned down by local panels. The same local panels were condoning speculative trash in the same areas at the same time. The code of design was being used to depress design down to the lowest common level by winkling out the unexpected examples of good contemporary work, whilst leaving the speculative builder, against whom the code was framed, quite unaffected. A similar result is to be expected from the efforts to impose local "traditional" design on the community through the Town Planning Acts, although, here again, the intention is excellent. Design cannot be procured by legislation. Codes of function and design can only be effectively applied in relation to a given level of cultural awareness and it is more important to take steps to raise the cultural threshold than to try to improve taste by restrictive decree. We decree that buildings must pass an examination panel but we do not dare decree that they must be designed by the most competent men we have, namely trained and qualified architects.

We can lay down the principle that, owing to the present meagre cultural level of the community, design standards or codes are to be deprecated. The principle is in accord with our conception that the minimum amount of standardisation consistent with efficiency should be the aim. We have so far discussed attempts to ordinate design by regulation, later we discuss positive design standards, an equal evil.

Codes of Practice

Our knowledge of materials and ways of building has grown through the years in an entirely unco-ordinated and empirical manner, but gradually building regulations based upon sound

or minimum practice have been built up. Gradually, too, a more exact knowledge of materials and building functions has been attained through the development of scientific research. This knowledge has, bit by bit, been organised into Codes of Practice for building and, in turn, the Code of Practice has served as the basis for standardisation or the issue of mandatory requirements. Thus steel and concrete codes have been made mandatory by incorporation in the L.C.C. bylaws.

The distinction between a code and a bylaw is not easy to draw since codes may be adopted as bylaws, and it seems probable that they will ultimately supplant them. A bylaw, as we know it, stipulates the legal minimum requirements of building, usually with the barest sketching in of details, whereas a code will be a code of good rather than minimum practice and set out the fullest details it is possible to give.

It is obviously an advantage to have the welter of available knowledge codified in simple and readily accepted form, providing that the codes are kept up to date and are couched in elastic terms. Some other countries have gone further than we have here in the organisation of their Codes of Practice, notable examples being the Canadian National Building Code, the Pacific Coast Building Code and the German Building Code. In all these cases the code replaces the local building bylaw and is drafted in such a way that it can be used in a mandatory manner. The First Report of the Codes of Practice Committee of the Ministry of Works, which gives an admirable and detailed exposition of the state of existing Codes of Practice and the development of codes, points out that all these codes "*bear evidence of having been evolved from elementary building regulations of British origin and they are usually, if not always, framed in such a way that they can, with slight modifications, be used themselves as building regulations*".

The present problem with Codes of Practice is, in the first place, one of co-ordination. The many existing codes require bringing up to date, redundancies and overlaps in them need to be expunged and very wide gaps filled in. On the Codes of Practice Committee of the Ministry of Works is vested the function of organising and completing the codification of building knowledge and regulation so that we may, in the course of time, achieve a complete code of building. In their First Report, published in January 1943, the general field to be covered is set out. It is

divided under two main divisions: Codes of Functional Requirements and General Codes.

The General Codes are being considered under these headings:
(1) Carcase.
(2) Finishings.
(3) Installations.

The Committee has adopted the conception that the new codes shall be statements of good practice rather than minimum requirements and there is no present intention of making them mandatory. When complete, they are to be used as a guidance to the industry. It is clear that, if this immense labour comes to fruition, a very complete and accurate textbook on materials and practice will be available to the industry, its value depending upon how up to date it can be kept, for it is no easy matter to keep such a mass of data always revised according to the latest practice. It may be expected to simplify the work of architects, engineers and builders by providing them with a quick reference norm, a common ground of agreement in dispute, a specification reference which will obviate pages of duplication in specification and contracts. For instance, instead of having to write out the exact and detailed procedure, standards of performance and quality of, let us say, plastering, a few sentences referring to the appropriate section of the code will be all that is necessary. We might easily see specifications whittled down from one hundred-page documents to twenty-page documents of more authenticity and accuracy, purely local variants will tend to be displaced by code standards.

Clearly, model bylaws, which are themselves a form of code for minimum practice, will need to dovetail with the new code. What will it avail to introduce a code which sets out the desirable functions of daylighting in terms of intensity of light for different occupancies if, when we come to deal with the local surveyor, estimable man, he puts his finger on the relevant section of the Model Byelaws, Series IV, Buildings, 88 (2), "Every habitable room shall be provided with a window or windows which shall open directly into the external air and have a *total area of not less than one-tenth* of the floor area of the room"?

Codes of good practice and codes of bylaw practice have not always tallied and it will be an immense task to ensure that they will do so in future, and an immense educational task to ensure that those officials responsible for the administration of the legal enactments are fully cognisant of the new codes and are prepared

to administer the bylaws in the spirit of the codes. Ultimately, surely, the bylaws will become anachronous and be supplanted entirely by codes, as on the Pacific coast of America.

So far, the most important contribution of the Codes of Practice Committee has undoubtedly been the drafting of preliminary Functional Codes. Many of these subjects have never been codified before and their appearance is a notable achievement. Functional Codes, as their name implies, attempt to set out desirable functional requirements of buildings, the degree of light and air required for various occupancies, desirable standards of sound insulation, of heat insulation, of weather resistance, of strength and stability, and so on. The difficulty with such classification is that it is sometimes arbitrary and the matter sometimes not easy to classify. For instance, a desirable standard of sound insulation through a party wall is set at 55 decibels reduction. An 8½-in. brick wall, plastered both sides, will give 50 db. reduction. The new code is somewhat better than the usually accepted party wall but it is by no means perfect and a lot of discussion has gone into this one decision to adopt 55 db. as a suitable figure. Clearly, 60 db. would be better and 65 db. better still. The codified figure is simply decided upon by a consensus of opinion as being a suitable standard for the time being. Some will agree with it, some think it too low and some think it too high. Functional codes are in their nature arbitrary standards liable to move one way or another in response to new conceptions of comfort, or new technical achievement, or new accessions of wealth or recessions into poverty on the part of the community.

Even so it is a good thing at any given time to be able to rely on code figures. Any question of inadequacy in an architect's design can at once be referred to the code—"but you see it *does* provide 55 db. reduction through the party wall, and it *does* provide a 2·0% d.f. in the kitchen and U for the walls *is* 0·15 B.Th.U". The architect is at once absolved from all blame. If, even so, complaints begin to come in, it is time to look into the code figures, the weight of responsibility is lifted from the shoulders of the designer on to the more ample and informed shoulders of The Code.

Though we welcome the appearance of these Functional Codes, without reservation, it is important to realise that they are still largely empirical. William Allen, than whom a better authority could hardly be quoted, has said (quoted freely) that "our design

has, so far, largely been based upon opinions. We are beginning to base design upon ascertained facts. Even the so-called facts are, in many cases, still opinions, but rather more informed opinions. Thus, the daylight factor (d.f.) is a mathematical statement, but if we say 2·0% d.f. is sufficient for a living-room we state an opinion, since we have not yet the available knowledge of the effect of light upon the eyes. We proceed from uninformed opinion to informed opinion. The statistical method is the method of giving us the utmost information upon which to base an informed opinion, but not yet a fact. The new functional codes are informed opinions."

So far ten basic Functional Codes have been drafted or are envisaged:

(1) Daylight.*
Sunlight.
Ventilation.*

(2) Space and Circulation.
(3) Precaution against noise.*
(4) Precaution against fire.*
(5) Loading.*
(6) Weather protection.
(7) Services—lighting,* water supply, etc.
(8) Heating and heat insulation.*
(9) Corrosion.
(10) Dirt and vermin.

Broadly, they collect into succinct form data gathered together by such bodies as the Post-War Building Study Committees sponsored by the Ministry of Works, and the labour of many years on the part of technical and government bodies. As a matter of expediency, the eight or so that have appeared in draft form have been confined for the present to a coverage of the requirements of domestic and non-residential school buildings only, these being the subjects of most immediate urgency. It is, of course, the ultimate intention to cover all types of building.

As an indication of the scope of these codes, that on Daylight takes 38 pages, that on heating 22, loading 19, the shortest, ventilation, fills 6 pages. It will be seen that the complete coding of the functional requirements of all types of building will take up a formidable amount of paper and the absorbing of the codes by designers will be an arduous process.

* Those denoted with an asterisk are actually in draft.

The seven provisional drafts available, those marked with an asterisk, are of somewhat unequal consistency, due largely to the limits to the extent of our knowledge. That on Ventilation is somewhat sketchy and this is, perhaps, one of the subjects where arbitrary decisions are inevitable in the present state of our knowledge. Precautions against fire, though an improvement on bylaws, are obviously also very tentative standards, informed opinions rather than facts. Thus, the empirical standards of the model bylaws gave the distances in feet of a building of given construction from its site boundary, or from another building.

The new code qualifies this as follows:

LOCATION OF EXTERNAL WALLS FOR HOUSES

(*a*) *Walls with Incombustible, External Covering*

Fire Resistance of Wall	Max. Nos. Houses in any one Block	Height of Wall above Ground	Minimum Distance from Site Boundary
Two hours and upwards.	—	—	No restriction
Less than 2 hours but not		Up to 12 ft.	3
less than 1 hour.	6	Over 12 ft.	5
Less than 1 hour but not		Up to 12 ft.	5
less than ½ hour.	4	Over 12 ft.	7

A more accurate statement but still only informed opinion. We can test with some measure of accuracy the fire resistance of a construction according to a standard test, and the apparatus for making such standard tests is in being. Thus, the requirement of 2 hrs. resistance for a party wall is a factual and more or less scientific correction on the old bylaw standard of 8½-in. brickwork and one that will allow the use of many types of construction for party walls that the bylaws would not allow, a great step forward. The readiness of fire to spread across an open space, however, cannot accurately be classified—it will depend upon the weather at the time—the state of the wind and so on. The Great Fire of London was due to inadequate fire breaks *plus* a strong east wind. The fire break standard is likely to remain for the present in the category of informed opinion.

One or two of the proposed Functional Codes are not so apparently desirable as the ones so far issued. These are the Codes for Space and Circulation, Weather Protection and Dirt and Vermin.

We speak without a text in discussing these proposed codes but

the subjects would not appear to lend themselves to precise codification.

How can we codify vermin infestation, the contemporary answer to which seems to be chemical rather than physical? Cracks and cavities can hardly be avoided in structures, D.D.T. or still newer and more potent insecticides will, surely, render the crack of no interest as a harbourage to the bed bug. Still less can space be codified. How much space does a man need to walk about in? To sit down in? To work at a desk? To say that a corridor should have a minimum width of 2 ft. 9 in. "if its length does not exceed so many feet" or 3 ft. 3 in. "if it exceeds so many feet but does not exceed so many other feet", might appear to be nicely rounded off, but would be utter rubbish. One or two functions of living could, perhaps, be codified into suitable tabular form as, perhaps, the floor space needed by a child at school for his desk, or the unit office with table and chair, but we cannot conceive of unit living-rooms per person. Each person according to the spiritual dictates of his mind has his different conception of the space he requires for living and it will go hard with him to have to fit into a codified "desirable norm" of good practice.

This criticism spills over into all the functional codes, even though we have nothing but praise for them so far as they go. In so far as they are aids to design they have our utmost support, but in so far as they seek to take the place of design we are bitterly opposed to them. You can codify light up to a point, you can state minimum approximate physiological needs, you can say a tall thin window gives more light per unit area than a long low one, and we agree. But proceed from this to say that, therefore, we *must* use tall thin windows and we are at once up in arms. There may be very adequate reasons not connected with lighting

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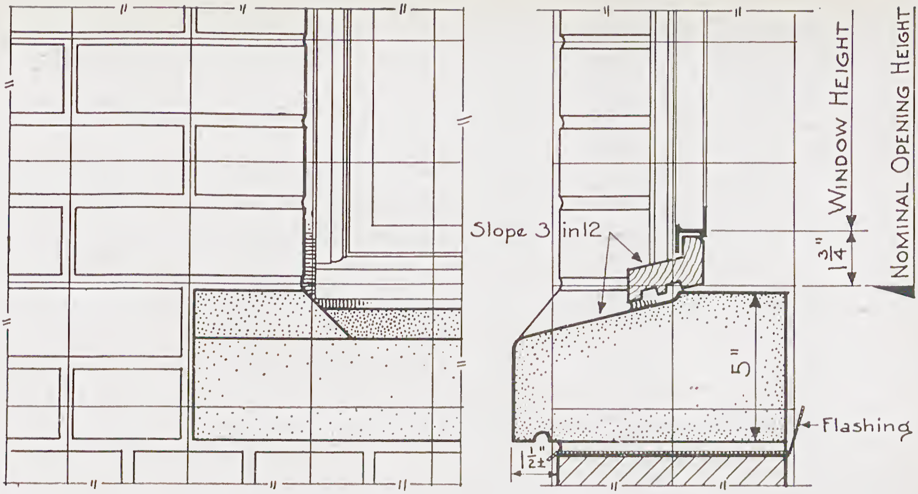
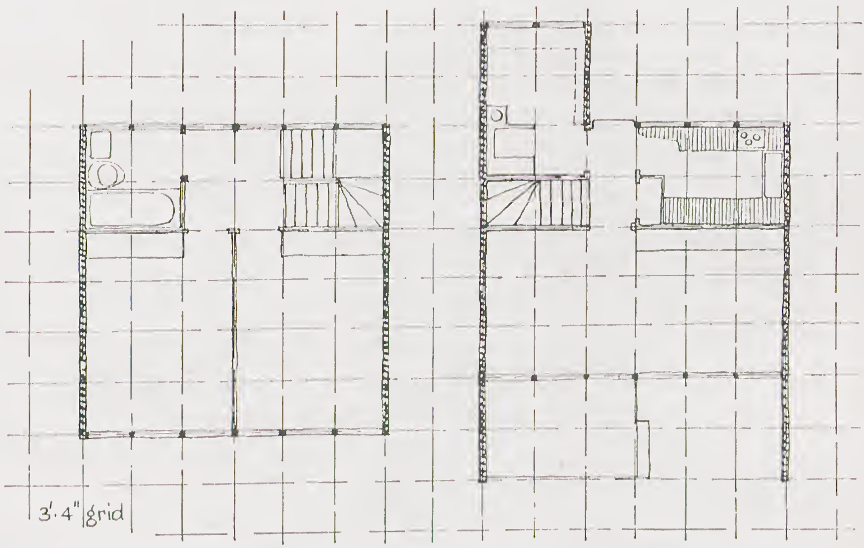
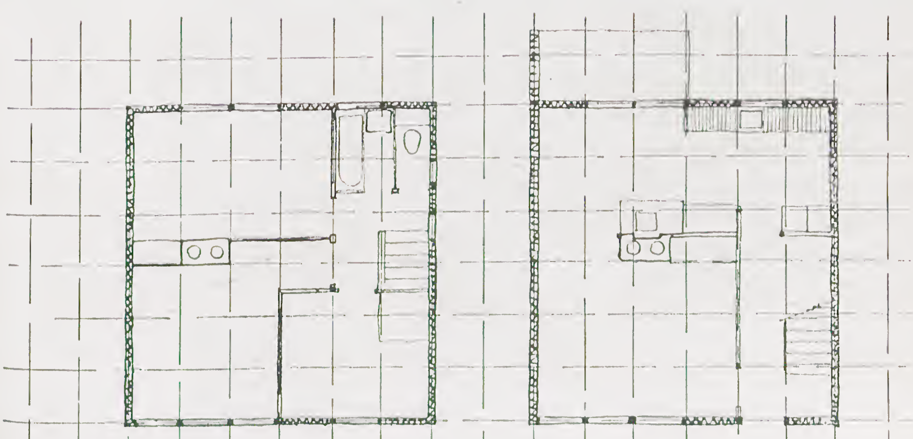
[RIGHT TOP] *Diagrams from Project A.62 published by the American Standards Association, to illustrate the application of the 4-in. modular increment in practice. The modular size, it will be noted, is the nominal or fixed dimension of the product and includes all allowances for jointing. All the products included in this diagram, excepting the sills, are now actually being produced to modular sizes in the United States.*

[RIGHT BOTTOM] *Plans laid out to modular grids of 3 ft. 4 in. and 3 ft. 6 in. Modular planning implies the avoidance of complicated shapes and niggling detailing. Economy is not achieved by scraping a couple of inches off the plan, to do so, on the contrary, puts the cost up, in that it involves the use of "specials" instead of standard parts. The rigid adherence to a figure of 900 ft. sup., an administrative measure quite suitable for controlling the cost of traditional brick houses, is obsolete as a method of cost control on prefabricated work. See also Japanese grid planning. A module of this order does not sacrifice flexibility beyond reasonable needs. Plans by Walter Gropius and Frederick Gibberd respectively top and bottom.*





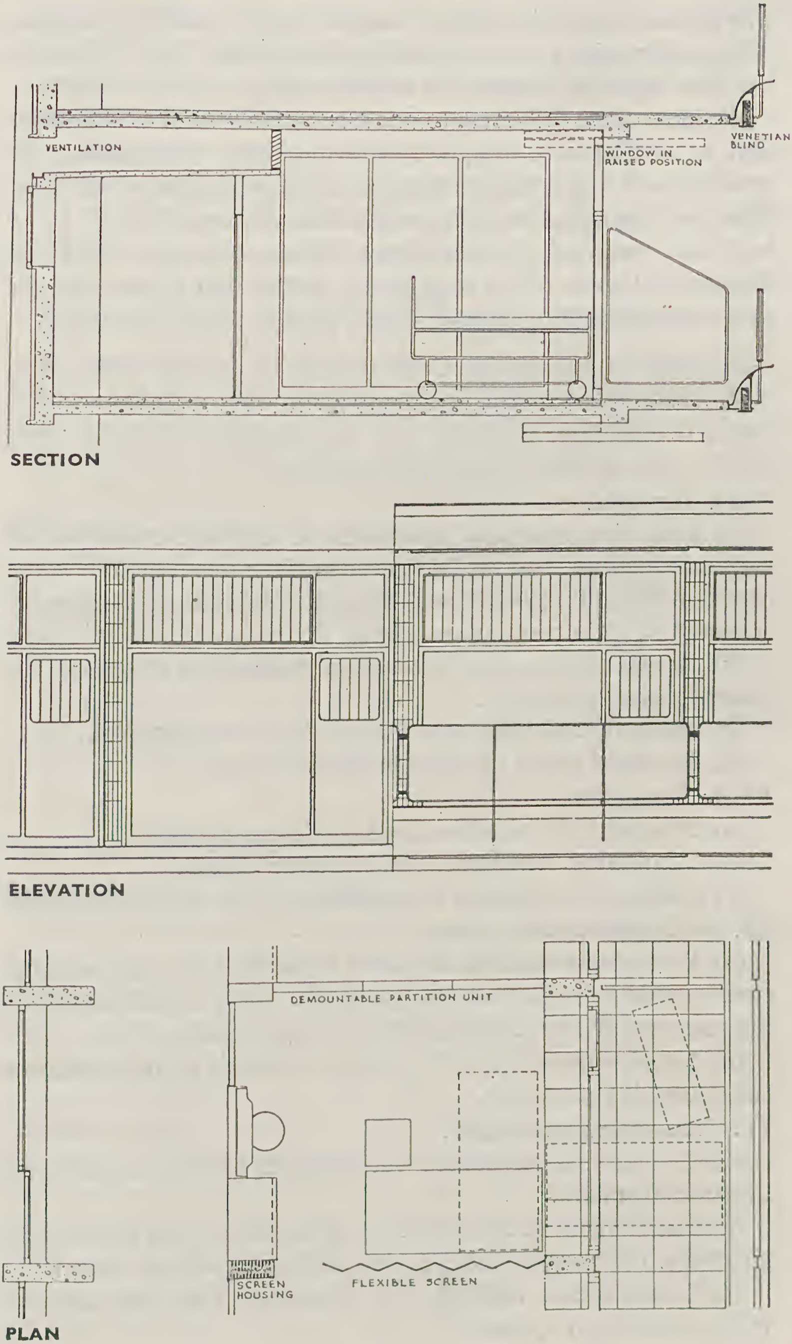
3'.4" grid



3'.6" grid

Details of the façade of the sanatorium from which the unit wards illustrated opposite are taken. The motives are repetitive and modular, standardisation in the factory is reflected by standardisation of the unit of the façade, creating an overall series of patterns which in their rhythm form the basis for æsthetic satisfaction. Architects, D. Dex Harrison and Penelope Whiting.

[OPPOSITE] *A unit ward for a sanatorium worked out on the basis of a 3 ft. 4 in. modular grid, the R.C. frame in this case being included in the grid, thus the frame is set out at 10 ft. 0 in. centres. The interior fitments are standardised and interchangeable. An alternative method for multi-storey work is to exclude the frame from the modular grid thus each interframe space is treated as a modular box distinct from its neighbour. Specials may be needed to join up the boxes. Architects, D. Dex Harrison and Penelope Whiting.*


VENTILATION
WINDOW IN RAISED POSITION
VENETIAN BLIND
SECTION
ELEVATION
DEMOUNTABLE PARTITION UNIT
SCREEN HOUSING
FLEXIBLE SCREEN
PLAN

9

why we want long low windows and they may be sufficient reasons. Always supposing that we know the requirements of good lighting, we want absolute freedom in the development of our designs.

We have come full circle to our basic thesis—that standardisation or codification should be the minimum compatible with necessity and that design standards should be avoided at all costs. *Hence we cannot tolerate the codification of space, for space is the basic raw material of the designer.* Hence, we must watch the Functional Codes with a wary eye to ensure that at no point do they transgress from factual standards into design standards.

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Synopsis of Functional Codes issued to date in draft form. N.B. All the Codes deal, for the present, only with the requirements of domestic buildings and non-residential schools. They are all codes of desirable or good practice.

I (A). *Daylight.*

(*a*) Lists the desirable standards of daylight required for various functions, thus 1% d.f. over half the room area in living rooms, minimum daylight area 75 sq. ft., minimum depth of penetration 8 ft. for a room up to 150 sq. ft.

(*b*) Simple statement of the design methods of obtaining the recommended standards.

(*c*) Siting of buildings and the relation of daylighting.

(*d*) Standard tables of window performance.

I (C). *Ventilation.*

(*a*) Standards for window openings (from bylaws).

(*b*) Ventilation standards with windows closed.

(*c*) Methods of attaining the standards of air change under (*b*).

III. *Precaution against Noise.*

(*a*) Desirable standards of sound insulation for various functions, outdoor noise and indoor noise. Thus, sound insulation between two living-rooms in different occupancies 55 db.

(*b*) Simple statement of the design methods of obtaining the recommended standards.

IV. *Precaution against Fire.*

(*a*) Two factors considered—1. exposure hazard, 2. restriction of external spread.

(*b*) Recommended standards are given for various parts of the structure. (See earlier table of standards of external walls.)

(*c*) Construction methods for chimneys, flues and hearths. (Developed from bylaws.)

(*d*) Description of method of testing the flame-propagating properties of the surfaces of materials.

(*e*) Classification of the surfaces of materials in terms of flame-propagating properties.

V. *Loading.*

(*a*) Superimposed loads on floors, and roofs.

(*b*) Wind pressures with the method of designing for wind pressure on buildings of different sectional type.

VII (A). *Provision of Artificial Light.*

(*a*) Discussion of factors affecting illumination.

(*b*) Standards of illumination for various occupancies. Thus, Living-rooms, Casual Reading, 6–10 ft. candles at working plane and description of how to attain this standard.

(*c*) Types of fitting, direct, semi-direct, indirect.

(*d*) Chart of lamp power for living-rooms.

VIII. *Heating and Heat Insulation.*

(*a*) Recommended temperatures for various occupancies and recommended standards of insulation. Thus, external walls of living-room, U not to exceed 0·20.

(*b*) Methods of assessing heat loss and calculating thermal transmission (U).

(*c*) Graphical method of estimating the desirable amount of insulation for parts of a building.

Standards Proper

Standards of custom and usage

Not all standards are formally adopted. We have said that the introduction of machinery inevitably involves a measure of standardisation—the machine turns out hundreds of products all alike and a standard product is automatically in being. The production of a machine tool to turn out a standard article may involve standardisation in a wide field, as the machine will be distributed to many manufacturers. This is one way by which a standard may be formed. As the machine tools get more complex and costly so must they turn out more articles if they are to justify themselves and we arrive at the extreme case of the modern strip mill which turns out steel strip of standard width and which costs several million pounds to install. These mills at present turn out strip to a maximum width of 4 ft. and to obtain

anything wider would involve putting in fresh plant to the tune of £10 to 20,000,000.

Clearly the machine will dominate the standard for a decade. Similarly, wallboards are made on elaborate machines which turn out the board in strip form and thus limit its width. Up to the present, industry has striven for bigger and bigger products, involving bigger and bigger machines and bigger and bigger capital expenditure. The first stage in production has been the setting up of a modest plant, succeeded by a bigger installation as the product justifies itself and finally by the mammoth installation.

The stage of the small and medium plants is still a stage when the size, shape, or general characteristics of the product can be altered with little trouble, but when the die is cast for the mammoth plant subsequent alteration cannot be effected until that plant is obsolete and ripe for being superseded—civilisation could not proceed otherwise, it must continue to make interim decisions.

Thus many product standards, particularly relating to dimension, have grown up around the machinery available. The product has increased its size as the facilities for making the larger sizes have been installed. The tendency for a standard throughout the industry has been assisted by the presence of the same machine tools.

Side by side with this development there is always a tendency, particularly where the trade is confined to a limited number of manufacturers, for these manufacturers to get together to agree on a standard size range for their products. Such agreement need not be formal, and it may have grown up by traditional acceptance.

Quarry tiles have only recently been incorporated in a B.S. (B.S. 1286, 1945) yet manufacturers of quarries have always made a limited number of standard sizes up to 12 in. × 12 in. and do not produce non-standard sizes except to special order. There is some reason for this in the limitation of firing to which these tiles are subject, but this alone is not sufficient to account for the standards adopted. Such a standard of acceptance will be brought about by the manufacturer offering certain wares, some of which will prove more popular than others and on these he will concentrate. When once a market has been formed for a particular line, "capital" in that line has developed and there is a tendency

for customers to re-use what they have used once or twice, out of habit. Thus, an accepted standard is formed and this might easily grow to national proportions. When there is little interchange of the product between district and district such standards of acceptance tend to remain local and to vary in each locality. Quarries, which are only made in one or two localities, attain a national standard because, from these localities, they are distributed all over the country, but until a few years ago bricks, which are made in nearly all localities, and are not usually transported from one area to another, varied in size from locality to locality as local custom had decreed. The time came when it became customary to transport bricks over much greater distances and it was necessary to standardise their size on the national plane, but even to-day there are three standard sizes for bricks, one applying in the South, one in the North, and yet a third in Scotland.

It is unusual now for a new product to be introduced without some agreement in the trade on a national standard size. Almost all trades are federated or associated at the national level as there are advantages of standardisation for the producer. Example: steel and wood casements, plasterboards.

Standards of this nature are uncorrelated and may not be the most serviceable possible. They are made by one only of the many interests involved and naturally they reflect the special desires of the manufacturers. In some cases a wider agreement is sought, but at times the "standard" is solely a dictation in the interests of the producers over the consumers.

Many of these standards by consent or usage ultimately get adopted as British Standards and have, thereby, an added authority. It is not always possible, when considering a new standard, to ignore the existing circumstances, such as the existing degree of capital already sunk in unofficial standards. If the machinery for making 4-ft. wallboards is in being, it would be useless folly to suggest a standard width of 4 ft. 6 in. for wallboards, or even 3 ft. 6 in., for then the machines would be running uneconomically. As the designers of the machines have rarely, in the first instance, considered aspects of correlation with other bodies, our standardising bodies frequently find themselves in a very difficult position when they wish to set up a standard; the economic pressure put upon them to ratify existing procedure and existing capital assets is immense and usually wins the day. Nevertheless, if we are to obtain correlation, such pressure must be resisted.

This must be done even if, for the time being, we must submit to two ranges of standards—those devolving from existing practice and those emanating from the new organised conception. It is conceivable that a standard width for wallboards might be fixed at 4 ft. so as to use up existing plant and a modular standard at one metre or two metres so that new plant, when it is put down, will conform to the new conception. This type of duality of standards will serve to smooth over the awkward interim period during which we cannot afford to scrap plant and have not yet the new plant available to replace it.

Vested interests

When a standard is formed, two types of vested interests in it arise.

(1) Interests due to custom and usage and acquired skills.

(2) Monetary or investment interests.

We have said that a standard should always be regarded as being flexible, but this has to be qualified, for the degree of flexibility it has in practice depends upon two things, the weight of administrative machinery that has to be moved before a change can be made and the resilience of the people who administer and use the standard.

Once a standard has been formed the element of thought and initiative in relation to the product in question is withdrawn. The manufacturer does not have to expend the time and labour in devising ways of getting "one over" on his competitors or of improving his product. The process of making the product tends to become one of automatic repetition. Nor does the user have to worry about the product. He knows exactly what he is getting, its quality and performance are prescribed. Its use becomes just as mechanical as its manufacture. In many respects this simplifying process is beneficial—one other process in human endeavour is reduced to a matter of mere mechanical application. It can be put at the back of one's mind as a problem already solved and the mind is free to concentrate on problems not yet solved—or it is free to become inert at having nothing to think about.

But the solution that is adequate for to-day may be inadequate for to-morrow. The mere fact of the existence of a standard, a problem solved, a problem which has ceased actively to occupy the mind of those concerned, implies that it will tend to drag on long after its inadequacy as a solution has been demonstrated.

Nobody thinks to alter it. The inertia of the human mind is a factor of great potency. We recall Newton's first law of motion—Every body maintains its state of rest or of uniform motion in a straight line except when it is compelled by some externally impressed force to change that state. We exaggerate, perhaps, and simplify, certainly, to make the point.

The setting up of an industrial standard involves some members of the community in capital expense in supplying needs implied by the standard. Machines have to be put down, factories built, operatives trained and accustomed to the new processes. Selling organisations set in motion, printing and literature distributed and the public convinced of the desirability of buying to the standard pattern. This may be a formidable, lengthy and costly process, and one not lightly to be cast aside. It is safe to say that a good part of the community's capital at any given time is invested in the maintenance of the standards which it uses.

The more upheaval a new standard involves in its application, the more essential it is that it shall remain as a standard for a sufficient time to justify the capital outlay for all concerned. It may be economic to introduce a standard for, let us say, a new range of quarry tiles for a period of two or three years or even less, but it would be impossible to contemplate a new standard bayonet fitting for electric lamps for any less period than a decade. A new size in quarries would need only the setting up of new moulds and the capital expenditure could easily be covered in a year or two, but electric plug sockets, the standard and the market for which is already international, and the article one for which replacements are constantly required, would involve the scrapping of plant and stock in all countries, and a new series of designs for both equipment and lamps thoughout the world, a formidable undertaking.

In varying degree there is a strong tendency to maintain a standard, once implemented, as long as possible and the tendency is always to maintain it beyond the time when objective reasoning would require it to be withdrawn or amended.

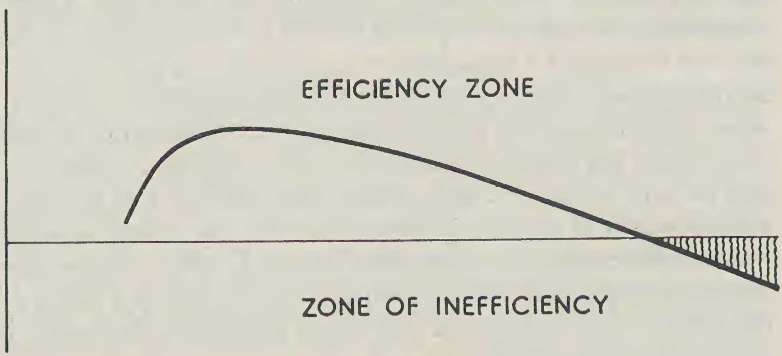
Not all the plant, etc., necessary in producing a standard product will reach obsolescence at the same time—a part will be obsolete whilst the rest is still efficient. Nor will the plant reach obsolescence necessarily at the same time as the standard itself becomes obsolete. There is, thus, an awkward period towards the end of the life of a standard, a period of increasing inefficiency,

until the time comes for the plunge to be made into a new standard.

Standards tend to be delayed in their application beyond the time when their need is apparent and to be delayed in their supersession beyond the time when their obsolescence is demonstrated.

Maintaining the efficiency of a standard

It may be assumed that, at the time a standard is formed, it will be as efficient as human ingenuity can make it. The elaborate machinery for producing standards ensures that, at any rate in practical matters, it shall not be found wanting. The standard, however, remains as it is until such time as it be revised. It is static, whereas events around it are constantly changing. Technically, and all the standards we are discussing are technical, society is constantly moving forward so that, by implication, the static standard is being left behind. If it were not revised there would come a time when, on balance, it served no useful purpose and, still later, a time when it became positively harmful. This point may be made by plotting an efficiency time curve which will have the general form:



Almost all standards follow such a curve, there is a short period at first when the value of the standard is beginning to be felt, then

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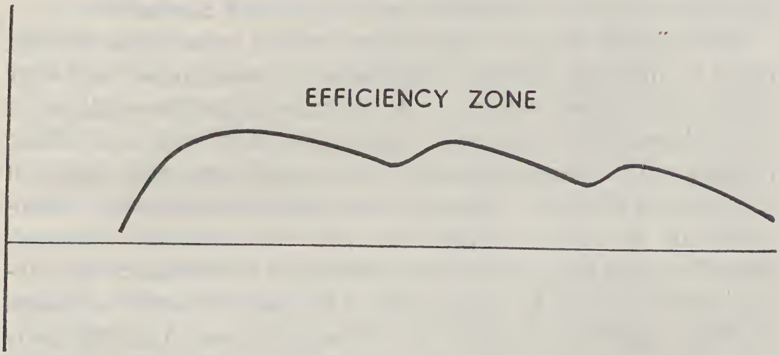
[TOP RIGHT] *Bylaw Housing. Needless repetition of pattern based on working down to minimum bylaw standards. The perfectly flexible medium of brickwork is used to create a standardised, sterile and bankrupt human environment. Housing is in the hands of the profiteer, who is not concerned with the results of his work. In the application of the regulations the well-intentioned sanitary enactments are stultified because the men who use them have neither social conscience nor imaginative insight.*

[BOTTOM RIGHT] *Between the two wars, suburban blight took on the slightly different, but equally sterile, formula: "12 houses to the acre" in semi-detached deserts of ever-encroaching magnitude. After this war, what then?*

a period of maximum efficiency and thereafter a gradual decline. If the standard is kept constantly revised it may be possible to maintain the curve at a horizontal line at its maximum level, but this will be exceptional. A more probable type of curve for a standard under constant revision would indicate a series of gradually diminishing apexes until the standard at last ceased to be worth a further revision. The time has then come to introduce an entirely new standard:



The causes of inefficiency are varied. They may be due to new technical developments such as an improved process of manufacture, or improved raw materials, or to supersession of one order of doing things by another, a common form being the ousting of mechanical methods of measuring by electrical methods.

[TOP] *The assembly line house. Prefabrication, which implies the adoption of standardised factory-made articles, imposes its standards on the finished house. There are degrees of prefabrication, from the standard unit product designed for stock, to the complete house built to a standard pattern on the assembly line, such as the T.V.A. house depicted above. The more probable trend of prefabrication will be the standardisation of parts rather than of the complete house, for which process, we have argued, the introduction of dimensional co-ordination is necessary.*

[BOTTOM] *Three lamp-posts:*

[LEFT] *Lamp-post designed by Decimus Burton, 1838, for a site in Hyde Park.*

[MIDDLE] *A familiar type of lamp-post.*

[RIGHT] *The proposed British Standard Cast-Iron Lamp-post.*

A new venture on the part of B.S.I.—the standardisation of style elements, so definitely condemned by Agnew. A little test: cover up the captions and see which of these three you like the best, then, which you think is the worst. After having done this turn back to the top illustration facing page 16 and see whether you had noticed the example of "A familiar type of lamp-post" in the middle of the picture. Probably you had not, it is rather unobtrusive and negative. Now try to imagine a "British Standard Cast-Iron Lamp-Post" in its place! We leave it at that.

They may equally be due to changing human outlook or fashion. All design standards are liable to be suddenly rendered obsolete in this way.

We instance our old favourite the standard range of steel casement windows for small houses, brought out just after the last war as a means of getting cheap metal windows for the post-war housing drive of the time. Until the introduction of this standard series, metal windows were a purpose-made luxury and the overall advantages of standardisation were at first enormous.

Within their design context they were a reasonable, though never an inspired, solution, based upon a standardised and very small pane of glass, which set the dimension for the whole series of windows. The period was one of a harking back to tradition in design and it was supposed that the steel casements would fit in very well with the "cottagy" and self-conscious rural atmosphere of the cottages which were then the vogue. So they may have done, but that period soon passed and the design of the windows was found to be inadequate to fit them into other contexts. A brief, inglorious period of "moderne" ensued in the early thirties when it was found that, by omitting a few of the vertical glazing bars and leaving in the horizontal ones, a simulation of novelty consistent with the banal level of design could be achieved and a standard series of casements with horizontal glazing bars was added to the list. It was, also, always possible to get the windows delivered without glazing bars, though the sections were so light that the manufacturers never wholeheartedly recommended this course, but the proportions of the windows were not considered primarily from the standpoint of barless openings and they are quite undistinguished in this form.

Now, after an existence of twenty years, during which our whole attitude to design has changed, we find all three of these permutations of the standard invalid for contemporary conditions. The standard now represents a barrier to progress. It is with the more horror that we find the old obsolete standards have been given a new lease of life by re-ratification in 1944.

This is yet a third stage: an old standard that has fulfilled itself and is ready to be put on one side, is one order of inefficiency, but to re-ratify such a standard, apparently for no other reason than expediency and lack of vision is an action on an altogether different plane.

We are inspired, as an instance of the extreme difficulties of

maintaining the technical efficiency of a standard, to tell the story of the development of an international concert pitch for orchestras, on the face of it a not very difficult matter to arrange. It is a story which brings into sharp relief many of the difficulties of standardisation we have been discussing. We quote freely by courtesy of the *Standards Review, 1945.*

In 1896 the new Philharmonic pitch (based on A=439 cycles per second) displaced in this country the old high concert pitch (A=452 c.p.s.). Three years later the new pitch was adopted for the piano. Before that time players had constantly to alter the pitch of their instruments when playing with the piano.

Players of wind instruments were affected most of all and not until thirty years had passed did the Army Council sanction the considerable expenditure on new instruments required before military bands could use the new pitch, which had by then become standard practice.

In the eighteenth century the variations in the pitch of organs which affected instruments played with them, had been a cause of difficulty. For example, Bach's organ at Weimar was tuned a minor third above the pitch then in general use for concerted music and, as a consequence, in Cantata No. 150 in which the strings and continuo are in B minor, the bassoon part is in D minor to permit the employment of a normal instrument with an organ pitched a minor third higher. The strings, of course, tune themselves to the organ.

In the nineteenth century, serious attempts were made to improve matters and much confusion was caused because of the somewhat unforeseen effect of temperature on pitch. A conference of physicists at Stuttgart in 1834 at Scheibler's suggestion adopted A=440 c.p.s. and it is known that Scheibler worked at a temperature of about 70° F. In 1859 the French Government established the pitch known as "diapason normal" based on A=435 c.p.s. Unfortunately, they standardised it in terms of a tuning fork at 15° C. (59° F.). This temperature is considerably lower than that normally reached in concert halls, which rises to nearly 70° F. For the flue pipes of the organ a rise of temperature of 9° F. raises the frequency of A by 4 or 5 cycles per second. This was one factor which led to the fixing of the new Philharmonic Pitch, in 1896, at 439 cycles per second with a temperature of 68° F. It explains why the new pitch was regarded as adapting diapason normal, in this country, to concert conditions. Diapason

normal adjusted to a higher temperature than 15° C. had meanwhile been generally adopted on the Continent.

It looked as though something approaching a standard pitch was becoming a general practice; unfortunately there was no effective means of maintaining it in practice. Traditionally, the oboe was used to give the pitch to which the orchestra was tuned, but the oboe itself is liable to considerable temperature variation. Its temperature rises in use as it becomes warmed by the player's breath and there is a corresponding rise in pitch. Similar, though not identical, rises in pitch take place with other wind instruments.

These facts were brought out by accurate electrical recordings of broadcast music which disclosed a general tendency to a variable rise in pitch. Hence, in 1939 a British Standard pitch based on A=440 c.p.s. was adopted and it had been recommended by common agreement as an international standard for concert pitch just before the war. It implied the least disturbance of performers or instrument manufacturers but its fundamental change was that it dethroned the oboe as a means of maintaining pitch, substituting a constant electrical frequency of 440 c.p.s. To this end the B.B.C. were prepared to broadcast a note of standard frequency daily and their orchestras were to be tuned to an electrical tone generator instead of the oboe.

DESIGN STANDARDS

THE standards of design by restrictive process, which we discussed in an earlier chapter, were not design standards proper but they had the result of producing a uniform and standardised product. Similarly, the standardisation of pattern by consent, as in the formulation of styles of architecture, is only a form of indirect design standardisation.

Any positive attempt at standardisation, however, also produces, either as a main object or a by-product, standardisation of design. Thus, if we prescribe the size, shape and content of a brick or any other form of block we have produced a design, a very elementary and simple design, indeed, but still a design. Not only that, but we have begun to effect the further designs which can be built up out of that product, a wall constructed of cubic bricks would look very different from one built of the horizontal rectangle which is in common use. By standardising the size, we have had an effect on the scale of our building, as witness the efforts to which some architects will go to obtain a brick of other than standard dimensions.

When the product to be standardised becomes more complex, so the restrictions on freedom of design are more apparent, and we have instanced in some detail the effect on design of the standardisation of metal casement windows.

Factory production, which implies the turning out of thousands of articles of a given type, compels not only standardisation of dimension and quality, but also a detailed standardisation of design. There was a time when each object, product of human hands, was designed singly and almost certainly differed from its brothers in some or other small particular. To-day, the factory-produced article is designed at the stage of the original mock-up and subsequently merely reproduced. There is no design element in the mass production process itself. Thus, design becomes a subject of standardisation so far as that article is concerned. The tendency is beginning to go further, simple things like door handles, windows, chimney pots, and so on, are proposed for standardising at the level of an industry or even at the national level. Individually, these may be small items but, collectively, they lead

to a monotony of sequence in our buildings, and particularly our houses, that results in a constant depression on the spirit. The niceties of proportion that differentiate one Georgian house from its broadly similar neighbour vanish; in place one sees the same window frames stuck in exactly the same holes in walls from South Devon to Middlesbrough and beyond.

In the Georgian period the accepted "mould" of the times gave the unity that was diversified by innumerable shades of design in the individual elements. The process is reversed. The individual elements are all identical, diversity is frantically sought in the outlines. The striving is vain inasmuch as the outlines are the subject of an unformulated but none the less insistent standardisation of economy. The speculative builder builds his houses all square and box-like, for that is the cheapest way of building them and he countenances no other. Our small houses are all much of a muchness, however we ring the changes on tudoresque, Georgian or moderne trimmings, within their identical total cube and shape, and with identical casements made to serve for all the "styles".

Stylising in a standard should at all costs be avoided. A manufacturer, if he is producing a baby's rattle, has, for economy, to standardise his rattle to a given design, but this is not a reason why that design for a rattle should be elevated to the level of a British Standard. There would be no economical advantage in making all manufacturers conform to a given detailed design for such a product and there certainly is no advantage of any other sort.

That it will result in economy is one of the chief arguments for standardisation, and the economy achieved might be in money or effort. If no economy is achieved there is frequently no argument for a standard and that is indeed one good test to apply. There is certainly no economy to be gained by standardising in minute particular the design characteristics of small objects, since each manufacturer has to make his moulds and the moulds will be the one major item of economy. In such cases only interfitting parts need be specified.

It is even questionable whether there is fundamental economy in standardising in elaborate design detail a range of windows. We would like to see the effect of limiting standardisation to the sections to be used and to the establishing of Bemis's co-ordinated jointing details applied to a modular grid. It would not appear

to be difficult to devise jigs on the modular basis which could knock up any variety of modular-sized window with equal facility. So far as stock goes, a few very basic types would be sufficient to keep the factories going steadily whilst leaving designers free to improvise their windows to the needs of their job.

The tendency to standardise design does not end here. Hitherto, B.S.I. have wisely avoided positive design standardisation as far as they could. There appears to be a tendency to change this policy. We quote from an editorial in *Standards Review:* "*The public has obtained, by pressure of opinion extending over many years, an increasing measure of protection against offensive smells and dirt. Full protection against offensive noise has not yet been achieved, and very little indeed has been done to protect the public against offences to the sight. As a result of this failure to guard the eyes and ears against abuse, these delicate organs have come to accept much that is crude and vulgar. This issue of* Standards Review *contains articles written to show how standardisation can help the public by protecting it against deterioration of the senses.*"

To begin with, there is a fallacy in this argument. Protection against smell, dirt and noise is, quite properly, a subject for codification and we have discussed the "Functional" codes that deal with this protection in a previous chapter, but we have also, in the same chapter, discussed the codes that deal with protection for the eyes on the same basis, viz. Codes 1A, Daylight, and VIIA, Provision of Artificial Light. Protection for the eyes in a quantitative or physical sense is certainly not being neglected.

The editorial, then, is referring to an altogether different kind of "protection"—cultural protection, protection from what are so aptly named eyesores. It is really suggesting protection for the mind rather than the eyes and ears. When we are codifying noise we give protection against sound in the quantitative sense, but we do not attempt to impose any other sort of censorship on the ears. We do not say: "no more jazz in future", or "no more saxophones will be allowed", or "drums must not be played in public". The matter does not even arise and yet it is difficult for a person with a sensitive ear to prevent it being bastinadoed by a very virago of sound of the most acutely unpleasant sort in the name of music and, certainly, our ears, no less than our eyes, have been debauched and ravaged in our general cultural depravity. We

are to beware of any attempt to upraise our culture by official legislation in the form of standard exemplars of design.

We have instanced the somewhat arguable value of mere negative restrictions to this end embodied in the Town Planning Acts or the Housing Acts, how design is, in fact, being forced down, as well as up, to the level of the lowest common denominator. Now we must arm ourselves against the B.S. standard lamp-post, the B.S. standard shop signs and the like, threatening to impose official-lowest-common-denominator-culture on us. In one of these cases provisional B.S. standards have already been drawn up for comment.

In advocating the advantages to be gained from a standard lamp-post, *Standards Review* gave three examples: one by Decimus Burton, a second, described as a "familiar type of lamp-post", presumed to indicate a post of but modest design pretentions, and a third, the "Proposed British Standard lamp-post", They were not a very happy choice. Decimus Burton's post, designed for a special site at Hyde Park, is a design of particular merit and elegance and a good exemplar of what a well-designed lamp-post might look like. The "familiar type of post", which has the mark on it of the ironfounder's catalogue, still retains some merit and is not unfunctional, nor does it lack grace in its upper parts. It is, indeed, a long descent from Decimus Burton, but a still greater plunge towards the styx is apparent in the parts of the third post—the "Proposed British Standard Cast-Iron Lamp-post". Here we touch rock bottom. There is neither elegance, nor delicacy, nor function in this hydra-headed bastard of the styles. We suppose it could be termed "moderne", though it does not even honour this discredited and fleeting fashion of camp followers.

There is the rub. The first attempt at official design standardisation produces an all-time low in lamp standards. Give us the rococo freedom of the Victorian ironfounders rather than this, let us at any rate have freedom. Have we not fresh before our eyes the standard telephone kiosk? One, and one only, very mediocre, over-dressed, red pepperpot of a design, has been planted all up and down the country with no regard to locality or amenity, until we become utterly sick of the wretched thing. The Post Office cannot have saved more than a few pounds over the universal standardising of this object and the aim of instant recognition, which was, we suppose, the primary reason for the imposition,

could have been as well achieved without the accompanying cultural sterility.

Official culture is not, it appears, culture of the very highest kind. It tends to be sound rather than brilliant. True, official encouragement is sometimes given to the brilliant in art, but to give encouragement is not the same as to possess. The ponderous official machine, and we imply here all ponderous machines whatever, is not a suitable vehicle for the finest flowering of the imagination. Our experience, indeed, is that official culture, though well below the top, *is* above the average of the mass and, by example, can help to improve cultural tone, but we would emphasise the difference between setting an example and imposing an example. One sets an example by erecting a good lamp-standard, whereas one imposes an example by telling other people that they must do the same *and* use the same design.

Culture cannot be handed out on a platter. It has to be worked for, the public cannot be "protected" against deterioration of the senses.

It may be that the child can be helped towards a better cultural understanding by being brought up in a beautiful environment, though it is by no means proved. He would probably be helped more by a change in the weight of values in society. When the time comes that leisure is valued more than material aggrandizement, then may we expect a keener sense of culture and a more critical perception. Meanwhile the little we can do at present is to foster the best of our designers and they are not fostered by the imposition on them of a standardised lamp-post. Let them all design lamp-posts, but insist that lamp-posts are designed by them instead of by a copy-draughtsman in the ironfounder's office or a second engineering assistant in the office of the Borough Engineer.

Agnew says that a standard does not stand still, but is simply the best way of doing a thing *at the moment*, but a design once done is always done, it is achieved, it is altogether different in conception from an evolving standard. Culture does not progress gradually, it goes forward or it recedes according to the fleeting genius of the moment, it is fluid, always changing. One man's culture is not another's and who is to say which is right? We, personally, do not like the standard lamp-post, but some may, and who is to judge between our preferences? Therefore, let us not have a standard lamp-post, for we can never all be pleased and to

favour one is to blot out the other. Culture, indeed, does not prosper in the totalitarian conditions where the official design is the only type of design that can obtain recognition—"it is destroying a certain portion of our liberty without just cause".

Let us close with this; it will bear imprinting in italics as a motto on all publications that have to do with standards—"*it is destroying a certain portion of our liberty without just cause and that is always a bad thing*".

POSTSCRIPT

"*Having made all the recommendations it considered desirable for the time being in the field of housing and school building, the Committee recommended that it should go into recess for a period.*"

With these words, with their indefinable air of suggesting a task well and truly done, the Standards Committee of the Ministry of Works publishes its Second Report and winds itself up. The Report appears when this volume has reached the page-proof stage and it is not now possible to adjust the argument in the body of the book to take it into account. There are two points, however, which we cannot pass over without comment.

Firstly "*The Committee . . . was pleased to note the Ministry of Health Circular No. 211/45 REQUIRING Local Authorities to use, for all building work assisted from official sources, except in certain special circumstances, a selected list of British Standards, and it trusts that before long the production position will permit of this list being EXTENDED*". Ah, well ! After trying for eighty pages to inculcate the principle of standards by consent, voluntarily undertaken. One stroke of the official pen makes our italicising of old Samuel Johnson's words at the end of our book seem an utter mockery. We feel rather like the railway committee who were told by their chief engineer, when the question had arisen what colour the engines should be, "You may have any colour you choose, gentlemen—providing it's black". The Committee then goes on to utter the pious hope that it "*does not feel that standardisation of components and materials will lead to standardised houses*". Possibly not, but the standardisation of standards implied by this move on the part of bureaucracy will lead to complete æsthetic debility and commercial barrenness. We cannot

believe that the circular will be implemented in the bald manner of its statement.

Secondly, we commend to our readers the Memorandum on Modular Co-ordination which forms Part 5 of the Report. Surely, there has never been so inept a statement on this subject? It is, in effect, an apologia to cover what we suspect to be a guilty conscience on the part of the Committee for not having based their new standards upon an organised dimensional pattern. The remarkable theory is advanced that co-ordination can be attained without the necessity of establishing a modular system. This is to be achieved—we suppose the Committee would say: this has been achieved—by "co-ordinating" *groups* of building elements, such as window or door assemblies, kitchen fitments and the like—"*but the same grid will not be suitable for all materials and methods*". Here is a pathetic effort to say, Oh, we do not like your modular idea, but we've tried our best to do it and, look, we have succeeded in bringing to birth a lot of little modules. Need we reiterate that the modular conception is nothing more than a simplified scale and that its one function is to supersede the innumerable possibilities in existing scales with one commonly accepted and limited range of sizes? Need we reiterate also that the modular conception is nothing if not an international one? For, finally, the Committee apologises itself into asserting that it really *has* used a modular conception—3 in., the True Blue British Module! Quite. This is indeed what we feared.

It has canalised the British building industry on old-established approved lines. Immediate expediency has always won the argument—where the basis for a standard already existed it has been accepted or re-enfranchised. Nothing has been attempted that would have involved a major upset of any sort. We cannot grumble that this Committee should have so performed, for it was established for that purpose, but we may object to its attempting to strafe itself with bigger issues, which it has signally failed to grasp. Like so many Government Committees, it has performed adequately on small measures and inadequately on large, and we may, with some relief, push the ball over to the infant U.N.E.S.C.O. whilst it is still young and untrammelled, and patiently hope that, when an international dimensional framework has been arrived at, this country will have the wit to tag along.

SHORT BIBLIOGRAPHY

The Evolving House—Vol. 3: Rational Design. Albert Farwell. Bemis, 1936.

Project A.62 for Co-ordination of Dimensions of Building Materials and Equipment. American Standards Association, 1941.

B.S. Handbook No. 3, Building Materials and Components. British Standards Institution, 1944.

B.S. Handbook No. 3, Building Materials and Components. British Standards Institution, Supplement, 1945.

A Survey of Prefabrication. D. Dex Harrison, A.R.I.B.A., A.M.T.P.I., J. M. Albery, A.R.I.B.A., A.M.T.P.I. and Penelope Whiting, A.R.I.B.A., Ministry of Works, 1945.

Specification. Annually by the Architectural Press.

Standards Review. Periodically by B.S.I.

Industrial Standardisation. Periodically by A.S.A.

The Use of Standards in Building: First Report of the Standards Committee, Ministry of Works, 1944.

Further Uses of Standards in Building: Second Progress Report of the Standards Committee, Ministry of Works, 1946.

First Report of the Codes of Practice Committee. Ministry of Works, 1943.

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